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ADDRESS AT THE COMMENCEMENT EXERCISES OF THE PHILIPPINE MEDICAL SCHOOL.¹

By PAUL C. FREER.

The physicians of the Occident are at present in a position far different from that of their colleagues in the Far East. There we have institutions of learning whose history extends over centuries, institutions in which the great advances of science have been made, institutions that have developed Faraday, Berzelius, Gay-Lussac, Liebig, Wöhler, Virchow, Pettenkofer, Nernst, Ostwald, Fischer, Pasteur, Koch, Ehrlich, and a host of others. There, those beginning their academic careers are brought in contact with a well-trained army of assistants and even with the masters themselves. They have at their disposal the great state laboratories and hospitals, are in the centers giving facilities for the international exchange of the results of research, and the comity between seats of learning gives to them not only the exactness necessary for the development of scientific investigation, but also the tolerance of the views of others which is essential to the thorough discussion of any subject. The great majority of the scientific journals are published in Europe and America, and in those continents the workers in science can digest the current literature of their subjects almost as soon as it is issued from the press. Great scientific congresses meet at frequent intervals, where discussion of recent advances spurs on the new endeavor; in short, in the Occident we have a scientific atmosphere which in every way favors the growth of medical knowledge.

In the Far East, on the other hand, until very recent years, the various

¹ Address, of the Dean of the Philippine Medical School: Read at the commencement exercises of the School, February 27, 1909, Manila, P. I.

countries and colonies have been in a state of greater or less isolation the one from the other; only with the development of steamship and rail communication have more comprehensive medical associations and a freer exchange of the results of investigation become feasible. Scientific work in the Far East has also suffered in the past most seriously from the lack of well-organized and extensive libraries, so that the profession at large, even if it had been animated by the most potent spirit of development could not have done the fundamental work necessary for any comprehensive piece of research.

Isolation produces stagnation, and more than that, gives rise to the growth of an insular conceit which not only is fatal to advance, but which even rapidly leads to retrogression. The isolated individual and community have no standards for comparison with others nor stimulus to the best endeavor, and inevitably a habit of thought becomes implanted, which accepts what was the best practice in the past as being equally advantageous to-day. This condition, with all due deference to what was accomplished in former times, has existed in the Philippine Islands. The Archipelago, isolated and with infrequent communication with other countries, was compelled to live within itself. The members of the medical profession, if they have no means of comparing themselves with the leaders of other countries and if they lack the stimulus of great libraries, are almost certain to develop into leagues on the one hand for mutual admiration and on the other for recrimination, with the result that development is checked and old and standard practices retained. Ever and anon fresh blood may be brought in from abroad, causing a momentary awakening which leaves a certain amount of permanent advance, but in the main, owing to the conditions which of necessity exist, its best effort is eventually lost.

However, in recent years a rapid improvement, not only in the Philippines, but throughout the Orient has been manifest. In Manila we now have a scientific library which gives access to all the recent literature, laboratories which subject the existing diseases to the search light of exact investigation and which give certain means of diagnosis and accurate statistics, hospitals where careful studies can be carried on, medical associations which bring us in contact with the members of the profession in contiguous countries, and a journal by means of which the results of the work accomplished can be placed in the hands of our colleagues throughout the world. Ambitious and well-trained investigators have now been coming to the Islands for a number of years, each bringing with him the latest experience and technique of the great laboratories of Europe and America, and each doing his part toward advancing our knowledge of tropical and other diseases.

The time finally arrived when, realizing that the means and men were at hand successfully to begin instruction in medicine by the same methods and on as high a plane as had so long been done

abroad, the Government established a Medical School for the purpose of bringing up young physicians who would be capable of using exact methods of laboratory technique and diagnosis and who would themselves be able to carry on the work of investigation so well begun. The period of stagnation has passed, the time for development has come, and the Far East, with its tremendous mass of heart-breaking problems and enormous wealth of new material, is finally coming into its own. The center for the study of tropical medicine will eventually be moved to this part of the world and Manila with the start already gained, will finally become one of the great centers of medical learning.

Although the time for stagnation is past and new conditions, which inevitably must continue to prevail and which must lead to further development are here, there are not wanting those who regard with a sceptical mind that which has been done and who deprecate the expense, effort, and sacrifice. Insular prejudice is difficult to overcome and to eliminate it altogether must take years of patient endeavor amidst circumstances of the most discouraging nature. However, conscious that we have followed the right path, conscious that our development has been real and not imaginary, and conscious that our work will eventually result in the greatest good to the greatest number, we can continue to ignore unjust criticism. Let us not forget that the true followers of the art of Esculapius in other countries have their trials as well, let us not forget that in other parts of the world true scientific work is often regarded as impractical and visionary, and that despite this, medical science has grown and developed marvelously.

The great mass of humanity, to say the most, are but slightly familiar with the achievements of modern medicine, and having but a superficial insight into the exact methods of scientific investigation are prone to regard the great modifications in practice which we encounter to-day, as compared with the principles followed even a few years ago, as the result of the controversies between various schools of medicine or as being due to the influence of different empiric doctrines upon the methods of thought of physicians. In so doing, they completely overlook, or ignore, the fact that since the latter half of the eighteenth century the development of science in all of its branches has proceeded with startling rapidity. In the few years preceding and following the French Revolution the methods of exact investigation became firmly rooted in the scientific world; and these methods, which before that time were confined to a few of the greater minds, were universally adopted. Quantitative study was developed in chemistry, and the bitter controversies in support of opposite views carried on by the devotees of that science, finally resulted in the present development of structural formulæ. This development gave to us the many dyes and stains without which modern biology would be far behind its present status. We obtained a clearer insight into the nature of the great group of carbohydrates, and the hitherto

nebulous field of proteins began to assume shape and form. Physiological chemistry was now placed upon a firm, scientific basis and the rapid application of its results to the general problems of the medical science was made possible. Physics, with its equally great development, has contributed as much as chemistry to the general advance. The study of electricity has given us resources which daily find application in physiology, biology, and in the practical branches of surgery and medicine. The work in optics produced the modern microscope with all its accessories and together with photo-chemistry the investigations on light have given us photography. The science of mathematics has grown equally with its sister subjects and joined with chemistry and physics has laid the foundation of what is practically a new branch of learning, physical chemistry. The latter to-day is called upon to explain phenomena and point the way to new research in almost all branches of medicine. Modern biology, with the aid of the microscope, has made us familiar with new classes of flora and fauna, and hence with bacteriology, protozoölogy, helminthology, and mycology. Histology and pathology have gone hand in hand, giving us new developments and new points of view each day. Physiology now makes use of all the resources of physics, chemistry, mathematics, and biology, and, together with anatomy and pharmacology, has become a branch of science to which specialists devote all of their attention.

As you all know, the development of this topic could be continued *ad infinitum*. Almost every branch of science has done its part in advancing medicine and bringing it to its present eminence. Medicine itself has produced the modern hospital where disease in all its forms can be studied and treated with the entire instrumentarium to-day available to us, and where the knowledge gained from experimental work in the laboratory can be applied.

What wonder then that the standpoint of modern medicine has altered. It is not the influence of this or that dogma or superstition, it is not the inner consciousness that this or that practice, previously held, is now untenable, nor is it the belief that to be progressive we must constantly change, that has brought us to our present standpoint. No, it is the great advance of scientific work and the methods of thought in general which have placed medicine where it is and made it, perhaps, the hardest taskmaster in the world. The human body, in health or disease, is subject to the exact laws of physical science and in striving to fathom the relation of these laws to life, medicine will continue to develop in the future as it has in the past. Beliefs and views we hold to-day must give way to others founded on still more extended scientific research, in the continual endeavor to reach that perfect knowledge we will never attain. There can be no differing schools of true medicine: there can be but one medicine, founded upon the laborious achievements of experimental, scientific investigation.

What if controversies, sometimes fierce and acrimonious, exist? They are solely brought about by different interpretations of actual results which are not yet sufficiently great in number or variety to throw the final decision one way or the other. It is one of the great characteristics of the scientific world that it is fundamentally sceptical and that it only gives unanimous acquiescence to an interpretation of facts which have been proved over and over again, until no doubt exists. Modern medicine is not tolerant of fiction or hypothesis: it demands exact observation, and woe be to him who comes before his colleagues with any statement which, with methods at command of the world at the time, he can not prove or for the confirmation of which he calls upon his imagination. Sooner or later someone will plow over the same ground and discover that what he was led to believe was soil of unusual fertility, is only barren rock and sand.

As medicine is founded on the exact sciences, and as the latter are constantly and restlessly advancing, accumulating new results and developing new theories, the physician can not mentally remain stationary. He too must hold the pace, must follow the work of his colleagues, must know the latest point of view and be able to use the latest apparatus. It is this very necessity for increasing the breadth of the physician's knowledge that was one of the prime factors in bringing about the almost universal formation of medical societies where discussion is free and where new results can be gauged at their true value; which has caused the publication of the mass of journals devoted to one or the other branches of the subject; which has founded the modern clinical laboratory, and which has given the services of so many of the profession to the hospitals and dispensaries. Especially the young physician, fresh from his institutional studies, must beware of the danger of lethargy, of believing that if he attends to such patients as he has, with such knowledge as he possesses, he has done his duty. The great procession will sweep by him and leave him, not only unprepared for his great task, but even a menace to the community.

To the graduating class I wish to say the following: The time to do your most energetic work is when you are young, and therefore do not neglect your opportunities. You have completed your academic course, the hospitals are your next school; in these institutions, with no fixed course of study laid out for you by a faculty, you will have opportunity to gain experience and knowledge in much greater degree than in the past, to contract habits of independent thought and to learn how to investigate. It is only by an earnest endeavor to continue your development, it is only by hard work, and above all by endeavoring to advance our knowledge of disease as it exists in the Philippine Islands that you can do your whole duty by the Filipino people who, by their sacrifices, have founded the school which has in part at least, given you your education.

SOME EXPERIMENTS ON THE CULTIVATION OF BACILLUS LEPRÆ.¹

By MOSES T. CLEGG.

(From the Biological Laboratory, Bureau of Science, Manila, P. I.)

The following experiments on the cultivation of the leprosy bacillus were confined entirely to an attempt to grow the organism in symbiosis. Believing that the leprosy bacillus derives its nutrition from the products of the tissue cells in the lesions in which it is encountered, and from the fact that it occurs so frequently within the protoplasm of these cells, an organism was selected which could be cultivated and which corresponded in a degree to the living tissue cells; that is, an organism containing a nucleus and protoplasm, the amœba. It was first necessary to procure a suitable growth of amœbæ and in this step the technique employed was the same as that recommended previously by Dr. Musgrave and myself in the cultivation of these protozoa. The culture media was composed of agar 20 grams, sodium chloride 0.3, extract of beef 0.3; it was otherwise prepared in the same manner as ordinary agar media for bacteria, the finished product giving a reaction of 1 per cent alkaline to phenolphthaleïn. The media was then placed in tubes and sterilized. The culture media when it is to be used is melted and poured into sterile Petri dishes and allowed to harden before being inoculated. The material containing the amœbæ is then spread in a thin layer over the surface of the media. If the proper symbiotic bacteria are present, the amœbæ will develop within two to ten days, depending upon the source of the amœbæ and the number and character of the bacteria present.

As intimated this media, an amœba, and its symbiotic bacteria were used in an attempt to cultivate the leprosy bacillus. A culture of amœbæ was obtained from a dysentery stool and after a sufficient growth of the amœbæ had occurred to overbalance the original symbiotic bacteria growing with the amœbæ, that is to say, when it would have been necessary to add a fresh supply of the symbiotic bacteria to the culture in order to obtain a further development of the amœbæ, leprosy bacilli were added instead. The inoculation of the plates with leprosy bacilli was accomplished by smearing the surface of the media containing the amœbæ with a portion of the pulp of a leper's spleen. The first series of plates was

¹ Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, February 11, 1909.

made from a case autopsied by Dr. Teague of this Laboratory. The spleen was removed aseptically and was found to contain enormous numbers of leprosy bacilli. The plates were smeared with portions of the spleen as described above and incubated for six days at a temperature of 37° C. Microscopical preparations were then made from the cultures, and stained with hot carbol fuchsin solution, decolorized and counterstained by Gabett's method. A great number of leprosy bacilli were found to be present together with short, plump, acid-fast bacilli occurring mostly among the clumps of the leprosy bacilli and associated closely with the amœbæ. Those organisms which from their morphology were evidently leprosy bacilli were undoubtedly carried over from the original source, that is from the spleen. Transplants from these plates were immediately made on fresh plates containing amœbæ and their symbiotic organisms, and incubated for two days at the same temperature. Slides were then prepared from this series of cultures and stained in the same manner. Microscopical examination showed that the short, plump acid-fast bacilli had increased in number, showing conclusively that the organism was multiplying. Control plates made at the same time, with the same amœbæ and in the same manner, except without the material from the leper's spleen showed no acid-fast organisms.

An attempt was made to cultivate the leprosy bacillus from a second fatal case of leprosy upon which the autopsy was performed by myself. The lungs contained tubercular cavities though there was no evidence of tuberculosis elsewhere. The spleen was removed aseptically and smears from it showed a fair number of leprosy bacilli. Inoculations were made from this spleen in the same manner as in the first case, the same strain of amœbæ being employed with similar controls. Microscopical preparations made four days after incubation of the culture showed a short, plump acid-fast bacillus identical in morphology to the organism found in the first case, together with clumps of the original leprosy bacilli inoculated from the spleen. The controls were all negative for acid-fast organisms and remained free from them.

CONCLUSIONS.

In the cultures from both of these cases an acid-fast bacillus is growing and multiplying which although it differs from the leprosy bacillus in morphology nevertheless may be that organism as we know nothing regarding the morphology of *Bacillus lepræ* on artificial media.

Obviously it is advisable to consider in detail the sources of error in these experiments: First, that of air contamination; this is hardly probable and I think can be excluded. Second, that of an acid-fast bacillus growing originally with the amœbæ. If such were the case the control plates should also show the presence of such an organism, whereas this has not been the case and there is no reason to suppose that such an organism may have been overlooked in the control plates when it was so plentiful in the plates inoculated from the leper's spleen. Third, the

presence of another acid-fast bacillus occurring in the spleen of leprous subjects. The fact that the acid-fast bacillus isolated from the two different cases is of similar morphology and is evidently the same organism in both instances would render it extremely improbable that it was a contamination from either the spleen or from the air during the inoculation of the plates.

This paper represents a brief résumé of my work on this subject up to the present time and is preliminary to a more extensive research already outlined. One of the first problems to be confronted is the cultivation of the acid-fast organism in pure culture with some well-known species of bacteria for the symbiotic organism and the amœba. It is now well known that amœbæ can not be cultivated without the presence of symbiotic bacteria. In the experiments described above the organisms growing in symbiosis with the amœbæ were unidentified. In as much as we know nothing regarding the morphology or biological properties of the leprosy bacillus on artificial media I shall first investigate the properties of the acid-fast organism growing in symbiosis with the amœbæ and a well-known species of bacteria such for example as the cholera spirillum or the typhoid bacillus. In this manner if the leprosy bacillus colonizes, I will probably be able to differentiate its colonies from those of the cholera or typhoid organisms (constituting the symbiotic bacteria), whose characters are so well known.

SUPPLEMENTARY NOTE.

Since presenting this paper I have succeeded in obtaining a growth of an acid-fast organism similar to that obtained in the first two cases described, from leprous nodules in the ear of three living subjects. I have also modified the media by using plain agar alone without the beef extract but the same amount of sodium chloride as was employed in the first experiments. The finished product should have a reaction of 1 per cent alkaline to phenolphthalein. The technique of the method of cultivation has not been changed. At the present time the acid-fast organisms grown from the first two cases are developing well on the tenth sub-culture and those cultivated from the ear are being grown on the fifth. All efforts have failed to grow the bacillus on any media without the association of amœbæ.

Repeated inoculations of the leprous material on the media containing amœbæ seems to be necessary in most cases in order to produce a primary growth of the acid fast bacillus. This may be due to the change in environment of the amœbæ caused by the addition of the blood and tissue cells from the spleen. Repeated inoculations of the plates probably allow the amœbæ to become gradually accustomed to this change in the media and in this way perhaps a satisfactory relationship for growth, between both the amœbæ and the acid-fast bacillus is obtained.

(For the discussion of this paper before the Philippine Islands Medical Association see p. 141.)

THE TREATMENT OF ASIATIC CHOLERA DURING THE RECENT EPIDEMIC.¹

By HENRY J. NICHOLS and VERNON L. ANDREWS.²

- I. INCIDENCE OF THE DISEASE.
- II. GENERAL MORTALITY.
- III. THE TREATMENT AND MORTALITY OF COLLAPSE.
- IV. THE TREATMENT AND MORTALITY OF URÆMIA.
- V. SPECIAL PROBLEMS.
- VI. HOSPITAL MANAGEMENT.
- VII. CONCLUSIONS.

I. INCIDENCE OF THE DISEASE.

An epidemic of 885 cases of cholera occurred in the city of Manila during August, September, and October, 1908. As the population numbers about 223,000, the percentage affected was a little less than 0.4 per cent. Fifty-nine and four-tenths per cent of the cases were males and 40.6 per cent females. As males make up 58 and females 42 per cent of the inhabitants, the incidence of the disease in regard to sex corresponded closely to the general population. The same is true, in a general way, of the incidence in regard to age as is shown in Charts 1 and 2.

While these charts show that, in a general way, cholera affected persons of both sexes and all ages in proportion to the number present, several exceptions should be noted. Proportionately more children of each sex under 10 became infected; the habits of small children may explain this increase. Proportionately less children of both sexes between 10 and 19 took cholera; no explanation of this fact suggests itself except

¹ Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, Manila, P. I., February 11, 1909.

This paper gives the results obtained in the treatment of cholera during the recent epidemic in Manila at San Lazaro, the regular isolation hospital, and at the Mary Johnston Emergency Hospital. A great majority of the cases were treated at San Lazaro, but the same general problems presented themselves and the same general conclusions were reached at both hospitals. Dr. R. P. Strong was consultant when the epidemic became severe and besides the writers the following took part in the treatment: Dr. Newberne, Dr. Teague, Dr. Bowman, Mr. Clegg, Dr. Sison, Dr. Guasson, and Dr. Laygo.

² Henry J. Nichols, first lieutenant, Medical Corps, United States Army; Vernon L. Andrews, bacteriologist and pathologist, Biological Laboratory, Bureau of Science, Manila, P. I.

that the instruction and warnings in regard to cholera infection which were given in the schools may have been effective. For some reason proportionately more females of ages from 20 to 29 were infected, and as a number of these women were pregnant, this accounts in part for the increased mortality among females from uræmia. This will be referred to later. In relation to treatment, it may be said that, if this epidemic is a typical one, preparations should be made to receive, during epidemics in the future, cases of both sexes and of all ages in proportion to the population and especial preparations should be made for receiving an excess of children under 10 years of age.

II. GENERAL MORTALITY.

Of the 885 cases 579 or 65.4 per cent died. Two hundred and ninety-eight or 33.6 per cent of the cases were found dead. Of the 587 discovered while alive 466 or 79.3 per cent were treated in the two hospitals. The general hospital mortality was 50 per cent. The hospital mortality for males was 48.7 per cent; for females 51.8 per cent.

Collapse and uræmia are of course the two essential conditions to be met in the treatment of cholera; if untreated, a great majority of the cases die in the first forty-eight hours of collapse; those who survive or are tided over the stage of collapse by treatment may die later of uræmia.

Everyone connected with the patients was strongly impressed with the value of intravenous injections of salt solution in the stage of collapse. Some criticism of this method, however, has been heard on the ground that the large amounts of solution which were frequently given might in some way increase the death rate from subsequent uræmia. Accordingly it will be well to give here the total mortality for each method of treatment from collapse and from uræmia and later to consider each separately.

In the first part of the epidemic only stimulants, such as strychnine and digitalin, were used for collapse, later subcutaneous injections of salt solution were introduced and still later intravenous injections came to be the routine treatment. The following table gives the total results. (In these tables 450 cases among Filipinos only are considered, a small number of whites and foreigners being excluded.)

TABLE I.—*Giving results of different methods of treatment.*

Method of treatment.	Number of—		Mortality.
	Cases.	Deaths.	
			<i>Per cent.</i>
Stimulation	145	47	32.4
Subcutaneous injection	175	117	68.8
Subcutaneous and intravenous injections	36	19	52.7
Intravenous injection	94	41	43.6

Under the head of treatment by stimulation all the mild cases are included so that the mortality appears small. As a method of treatment of severe collapse this method is generally recognized to be of the least value.

As may be seen, the number of recoveries in the cases treated by the intravenous method is 25.2 per cent greater than in those treated by the subcutaneous method and 9.1 per cent. greater than in the cases treated by the combined method.

It may be argued that as the method of intravenous injection was employed toward the end of the epidemic, the apparent superiority of this method was in reality due to a diminished virulence of the disease. The facts, however, are as follows: The epidemic was at its height from September 19 to 26. The method of intravenous injection as a routine measure was begun about September 26. The general mortality in the city from August 1 to September 25 was 67.3 per cent; from September 26 to October 31 it was 62.3 per cent. Hence the mortality in the last part of the epidemic was only 5 per cent less than that of the first part. This decrease may be much more reasonably attributed to the increased facilities for finding and treating cases than to a reduced virulence, but in either case there remains a substantial gain in the recovery of the cases treated by the intravenous method.

Chart 3 illustrates the curves of total mortality in the patients treated with the two methods and for the different ages of the patients and shows that the intravenous method was more advantageous for all ages; its superiority was shown to be least for cases from 20 to 29 and from 60 to 69 years. In making the curves relating to age, a total of 409 cases was used, 162 being treated by the subcutaneous method and 87 by the intravenous; the charts of the remaining individuals were incomplete or unavailable.

III. THE TREATMENT AND MORTALITY OF COLLAPSE.

TABLE II.—*Showing the results of the different methods of treatment in collapse.*

Collapse.	Cases.	Deaths.	Mortality. <i>Per cent.</i>
Stimulation	145	27	18.6
Subcutaneous injection	175	96	54.8
Subcutaneous and intravenous injections	36	9	25.0
Intravenous injection	94	19	20.2

The above table gives the results of treatment from which it may be seen that during the stage of collapse the mortality in the cases treated by the intravenous method is 34.6 per cent less than in those treated by the subcutaneous method.

Chart 4 gives the curves of mortality of the patients of different ages

treated by the subcutaneous and intravenous methods and shows that the latter method gave better results regardless of the age of the patient, but that this was least apparent in the cases under 10 and over 60 years of age.

The average number of intravenous injections of salt solution given to those who recovered was 1.8, the average number given to those who died was 2.6. The highest number of injections given to those who recovered was 5; to those who died 6. The average number of injections given by the subcutaneous method was 1.4 for both those who died and for those who recovered. The highest number of subcutaneous injections given among those who recovered was 3, among those who died 5. Undoubtedly if the method of subcutaneous injection had been employed more frequently, more cases would have been saved, but the maximum activity of physicians and nurses was reached as it was.

The apparatus used in administering the injections intravenously is illustrated in fig. 5; it is believed to be of the greatest value in the treatment of cases of cholera. The salt solution employed (0.85 per cent) was prepared in the Biological Laboratory of the Bureau of Science and was sterilized and sealed in 1- and 2-liter bottles. It was brought to the hospital as needed. When a bottle was to be used the cork was loosened and the bottle heated in the hotwater bath to about 43° C. A two-way rubber cork with one long glass tube for the admission of air and a short one to which a piece of rubber tubing was attached, was kept in a weak carbolic solution and when required for use, was firmly inserted into the neck of the bottle, immediately after the withdrawal of the original cork; the bottle was next inverted in the rack and the solution allowed to run from the tube until warm. For insertion into the vein only a few instruments are necessary: a sharp scalpel, a thumb forcep, a grooved director or other similar instrument for introduction under the vein, ligatures preferably of silk, and a medium-sized hypodermic needle, or canula. After the bottle of salt solution had been prepared as stated above, the method of procedure was as follows:



FIG. 5.

A clean towel was placed under the foot or arm of the patient to protect it from the bed clothing, the skin over the site of the operation was cleansed by a cotton or gauze sponge wet with alcohol. Usually the long saphenus vein

just above the internal malleolus, or sometimes one of the veins of the arm was selected for the injection. If a needle was used it was either thrust directly into the vein, or more commonly a small incision was made, the vein exposed and then the needle inserted. If a canula was used the vein was dissected from the surrounding tissue, the grooved director inserted beneath it, and the vein ligatured at its distal end. A small, longitudinal incision was then made in the vein above the ligature, the canula inserted, and the salt solution allowed to flow. At the close of the operation the vein was tied above the incision, a dry gauze dressing applied and the part bandaged. In some cases iodoform powder was dusted on the wound before bandaging. On the average about 1,500 cubic centimeters of saline solution were injected at a time, although the amount employed was controlled entirely by the condition of the patient. If the introduction of 500 cubic centimeters of saline solution was sufficient to give rise to a good strong pulse the injection was discontinued; on the other hand, 2,000, 2,500, or 3,000 cubic centimeters were sometimes employed to produce this result. Sometimes it was very difficult to get the solution to enter the veins, owing to their extremely collapsed condition, but by rubbing the limb toward the trunk this difficulty was eventually overcome. If the same patient was given several injections the same vein was frequently used twice. In this case the second operation was conducted in a similar manner to the first except that it was performed from an inch to an inch and a half higher up on the vein. After the vein was opened it was pressed upon to expel any clot that might have formed from the previous operation.

This method of intravenous injection of saline solution is considered to be the most advantageous yet adopted; the advantages derived from its use in overcoming collapse as compared with those from the employment of the subcutaneous injections are its directness, simplicity, and minimum of discomfort for the patient and minimum of time and attention for the physician. As most of the patients came to the hospital in collapse, the injection was usually given at once and repeated as often as the pulse seemed to be failing.

The administration of saline solution in cholera is often called symptomatic treatment, but if the symptoms are in part due, as they seem to be, to a loss of the body fluids, the treatment is to this extent specific. Whether or not the loss of the fluid is due to the mechanical irritation of the cholera vibrio in the intestines or to the toxins of the organism, or to both acting together, the restoration of the fluid in the vascular system is indicated. Attempts to stimulate the heart with strong stimulants, such as strychnine, digitalin, spartein, camphor, etc., do no good, because the heart has nothing to act on. There must be sufficient fluid in order that the heart may carry on its functions. We became so convinced of this in the treatment of cholera that whenever a failing pulse was noticed or a case was admitted into the hospital in collapse we hastened to give an intravenous injection of saline solution rather than a hypodermic injection of strychnine. The results were often dramatic. The respirations which formerly were rapid and difficult became easier, the pulse good, and the general comfort and condition of the patient greatly improved. The almost lifeless individual became again able to speak

and to observe what was going on about him. In some instances this transformation was very striking. The only untoward effects noticed after the injections were occasional chills, but these passed off without any apparent ill effects. We do not wish to convey the idea that stimulation in addition to the liberal use of salt solution is never necessary, for it is essential sometimes and must be used. Cramps in the extremities result from lack of fluid in the tissues and were treated by an intravenous injection of saline solution and *not* by a hypodermic injection of morphine.

In giving the intravenous injections the pulse and respirations were watched carefully and at the least untoward symptoms the injection was stopped. Sometimes after the solution had been flowing for a few minutes the patient would take a few shallow breaths, gasp, swallow and act as though choking. The introduction of the solution was stopped immediately, the patient allowed some time to rest, and if necessary treated again later.

In the intravenous introduction of saline solution there seems to be a point up to which the solution can be given and good results obtained, if this is gone beyond, the fluid passes out through the intestines almost as fast as it is injected. It is not always easy to determine when the injection should be discontinued. In collapse, the fluid part of the blood is withdrawn and its organic constituents concentrated. Now, if we could recognize when we had injected just sufficient fluid to restore the normal ratio between the solid and fluid parts of the blood this might be the signal for stopping the injection; going beyond this point might increase the fluidity beyond normal and set the current the other way.

Besides the introduction of saline solution either subcutaneously or intravenously, hot saline enemata, consisting of two liters of fluid, were given every six to eight hours. In this manner the lower part of the intestines was kept washed out and a good effect on the kidneys produced. For a while for excessive diarrhoea chlorodyne was given in 1 to 2 cubic centimeter doses every three to four hours, but it seemed to do little good and was not used much in the latter part of the epidemic. Hot tannic acid enemata (1 per cent,) were frequently given for diarrhoea and seemed to check the condition better than any other treatment. The warmth of the patient was sustained by hot water bottles.

The patients were encouraged to drink copiously of water so long as it did not induce vomiting, but at the first sign of nausea the liquid was restricted and given only in very small quantities or small pieces of ice were administered by the mouth. A solution of cocaine (0.016 gram to 4 cubic centimeters of water) was given to control vomiting and usually proved efficacious. Hiccough was often quite troublesome and obstinate to overcome. Aromatic spirits of ammonia (4 cubic centi-

meters), ether (1.2 to 1.7 cubic centimeters), or cocaine (0.016 gram to 4 cubic centimeters of water) were employed in the treatment of this symptom.

As to diet, for the first twenty-four to thirty-six hours no nourishment was given; after this time rice water or soups and broths and coffee were administered. The amount was limited, however, a cup of soup with a little coffee was usually more than a patient would care to take at one meal. As the patient began to convalesce a larger amount was given or a soft diet allowed. This usually consisted of soft toast and rice water with some rice. A liberal diet was gradually substituted.

IV. THE TREATMENT AND MORTALITY OF URÆMIA.

TABLE III.—*Showing the results obtained by the different methods in uræmia.*

Method of treatment.	Cases surviving collapse.	Deaths from uræmia.	Per cent.
Stimulation	118	20	16.9
Subcutaneous injection	79	21	26.5
Subcutaneous and intravenous injections	27	10	37.4
Intravenous injection	75	22	29.3

It will be seen that among the cases in which no saline solution was injected the mortality from uræmia was 16.9 per cent. The worst cases of collapse are apt to develop the most severe uræmia. These cases are largely saved from death in collapse by intravenous injections, but are more likely to develop uræmia than the less severe cases which pass through collapse without having received heroic methods of treatment. Hence the increase of uræmia by 12.4 per cent in the cases treated by intravenous saline injections is to be expected; moreover the small difference of 2.8 per cent in the mortality between the cases treated by the subcutaneous and intravenous methods also argues against the production of uræmia by the intravenous method and gives no ground for fear in the liberal injection of saline solution into the veins as compared with that into the subcutaneous tissue.

Therefore, from the results of treatment in these cases, there is no doubt that the method of intravenous injection of saline solution in cholera is much superior to any other form of treatment as it reduced the mortality from collapse and did not increase in itself the mortality from uræmia.

Of the cases treated intravenously who survived collapse, 45.4 per cent developed uræmic symptoms more or less marked; of these cases 64.3 per cent died and 35.7 per cent recovered. Figure VI shows the ages of those who developed uræmia and the percentage of those who died of it. Treatment was most effective between 20 to 29 and 40 to 49 years.

In dividing the treatment of Asiatic cholera into that of collapse and of uræmia, the writers wish to emphasize the importance of the latter condition as a sequela, which the text-books speak of as the "reaction stage" or state of "cholera typhoid." In the recent epidemic, at any rate, the symptoms of this stage were those of uræmia and consisted of a bounding pulse, labored breathing, flushed face, and coma. The treatment of uræmia should begin, if possible, before the clinical signs appear. As stated above, the severe cases of collapse may be expected to develop some uræmia and as soon as reaction had occurred mild diuretics were administered to these cases; large rectal injections of hot saline solution were also given, and in addition cupping over the kidneys was employed. The patient was encouraged to drink large amounts of water and of lemonade. A little later, as the pulse began to bound, hot packs were given in some cases, but because the patients sometimes became frightened by this procedure, and because of the mental disturbance produced causing the patient to struggle violently against it, the pack was discontinued. As the native people become more used to hospital methods, the pack can probably be used to greater advantage in the treatment of cholera.

In the early part of the epidemic, sweet spirits of nitre was given as a matter of routine from the time of the entrance of the patient into the hospital until convalescence had been established. Toward the close of the epidemic an effervescing solution of potassium bicarbonate and citric acid was given *after* the kidneys had begun to secrete urine. No benefit could be noticed from the use of any medicinal diuretic. Of all the measures used to induce the kidneys to secrete, that one of giving large rectal injections of hot saline solution was the most successful and gave the best results. Many times enemata of 4 to 6 liters were given five or six times in the twenty-four hours, instead of three or four times as in the case of the ordinary enemata. The patient was given as much as he could hold comfortably of these large injections and then allowed to pass it, then more was given.

In the most severe cases all measures, such as venesection with intravenous injection of salt solution and constant stimulation by hypodermic injections, were of no avail; and to us the most "grievous picture of the disease" did not constitute the thready pulse, sighing respiration, shrunken features, and clammy skin of collapse, but instead the bounding pulse, the labored breathing, swollen face, and wandering mind of uræmia.

Among the less severe cases of collapse it was impossible to tell which would develop uræmic symptoms, although careful attention was paid to the urine. A systematic examination of the urine was started in the hope of finding some indication of the approaching uræmia, but the epidemic terminated before enough cases were studied. The results as far as they were determined are as follows:

TABLE IV.—*Showing the results of urinary examinations.*

Day.	23 recoveries.				6 deaths, uræmia.			
	Quantity of urine.	Albu- min.	Urea.	Total solids.	Quantity of urine.	Albu- min.	Urea.	Total solids.
	cc.				cc.			
First-----	18	1.5	0.8	3	17	1.0	0.05	0.5
Second-----	188	1.6	2.0	5	10	3.0	0.06	0.4
Third-----	745	1.0	12.0	17	50	1.7	0.22	1.1
Fourth-----	1023	0.9	17.0	23	60	1.6	0.2	1.3
Fifth-----	1337	0.7	20.0	27	153	2.0	0.4	4.0
Sixth-----	1764	0.5	24.0	30	125	2.0	1.0	4.0
Seventh-----	1810	0.5	30.0	34	160	2.0	2.0	4.0

The albumin was simply estimated by the eye with the nitric acid test as of degree 1, 2, or 3. The urea was estimated by the Doremus apparatus and the total solids by the specific gravity. The average amount of urine per day per case was as follows:

TABLE V.—*Showing the average urinary results.*

	Quantity of urine.	Albu- min.	Urea.	Total solids.
	cc.			
Recoveries-----	900	0.3	13.0	18.0
Deaths-----	72	2.0	0.7	2.0

The average time of convalescence was five days, the average fatal case lived six days. The number of cases is too small for the figures to be conclusive, but some such method of examination as illustrated by this table might be of value in order early to direct proper treatment to the uræmic cases.

Intestinal paralysis occurred in a few cases, and as a rule was very intractable. This condition sometimes was relieved by hot turpentine stupes applied to the abdomen over a long period of time in connection with hot saline enemata, with the rectal tube left in for a variable period to draw off the water and gas. Later, small doses of calomel followed by magnesium sulphate were given, but owing to the denuded condition of the intestine and the lowered vitality of the patient these drugs sometimes produced a bad effect.

As a result of the subcutaneous injection of saline solution, abscesses occurred in only two cases, once under the breast and once in the groin. When one considers the large number of injections that were given and the confusion that attended the giving of many of them, one is surprised to find that more abscesses did not develop.

In a few cases a general urticarial-like rash appeared. This was in patients in which the uræmic symptoms were well marked and in which the convalescence extended over a longer period than usual. None of

these cases proved fatal and the rash, although it caused a slight itching sensation, which was relieved for the time being by sponging with a solution of sodium bicarbonate, seemed of little importance.

V. SPECIAL PROBLEMS.

Among the many puzzling and worrying incidents that the physician in a cholera epidemic has to contend with, none perhaps will cause him more anxiety than the treatment of the children and pregnant women. To stand by the bedside of the little ones and witness their intense suffering without being able to bring relief is very distressing. Their veins are so small that in their collapsed condition it is in many cases impossible to give an intravenous injection of saline solution. In such cases subcutaneous injection of the solution is the only alternative but on many occasions it seems to do little good. In addition to the attack of cholera the native children here, are almost invariably infected with round worms which for some reason seem to manifest an increased activity at this time. Possibly the presence of the cholera toxin and the increased intestinal peristalsis are accountable for this action, for certain it is that they are frequently passed by the mouth as well as by the rectum. As many as fifteen large worms were pulled from the throat of a child at one time during an attack of cholera. At first small doses of calomel and santolin were given for this condition, but owing to the great depression produced by this treatment it was soon stopped and nothing was done during the attack to expel the worms. Their annoyance to the patient occasionally is great, sometimes almost choking him. Convulsions are not uncommon in children, and all of the cerebral symptoms seem to be more prominent than in adults.

With pregnant women, inasmuch as they almost always abort, one asks one's self the question: Should abortion be produced as soon as the patient enters the hospital or should the physician let nature take its course? We preferred not to interfere for the following reasons: First, these patients, like the others, usually entered the hospital in collapse; and, second, were never thought to be strong enough to withstand the shock of artificially produced abortion. While pregnancy lessens the chances of the patient's recovery such cases do not necessarily prove fatal. In our experience at San Lazaro we had several women who recovered after abortion. The term of pregnancy ranged from three to eight months. Other things being equal, the earlier the case is treated the better the patient's chances are for recovery.

A bacteriological diagnosis was made in nearly all cases within twenty-four hours by Mr. Clegg of the Biological Laboratory of the Bureau of Science. This was of much assistance in handling suspects. Two consecutive negative reports of the stools or contents of the rectum were required before the patient was discharged from the hospital.

VI. HOSPITAL MANAGEMENT.

As is the case in most cholera epidemics, this one was unexpected and it was some time before the accommodations, the number of physicians and nurses, and the supply of apparatus and medicines were such as would have been provided could the epidemic have been foreseen. In an ideal cholera hospital the following conditions should exist: There should be three classes of medium-sized and accessible wards for handling the worst cases among men, women, and children either at the time of their admission or as they develop. In each ward for every six patients there should be one nurse, one helper, one physician (or medical student under the direction of a physician) and all the necessary apparatus. There should be larger wards for mild and convalescent cases and a separate ward for cholera suspects. A definite system for disinfecting and storing patients' effects: sterilization of linen and good laundry facilities should be in force. Large sized toilet rooms which are easily disinfected and kept clean and readily accessible are absolutely necessary, as is also sufficient help to scrub thoroughly the floors of the wards with some strong disinfectant at least twice a day. A small laboratory for bacteriologic diagnosis and urinary analysis should be at hand.

VII. CONCLUSIONS.

1. With regard to sex and age cholera occurred in proportion to the population with an excess of cases in children under 10 years.

2. Intravenous injection saved about 80 per cent of the cases from collapse.

3. Nearly half of those who survived the stage of collapse showed some symptoms of uræmia and nearly one-third died of this complication.

4. In general, the intravenous injection of saline solution greatly reduces the mortality from collapse; the more often the patients survive collapse, the more important becomes the treatment of the subsequent uræmia; with the present methods of treating uræmia only about one-third of the cases recover.

(For the discussion of this paper before the Philippine Islands Medical Association see p. 141.)

ILLUSTRATIONS.

FIG. I. Chart showing the incidence of the disease as compared with the existing male population.

II. Chart showing incidence of the disease as compared with the existing female population. Both charts show that a larger percentage of both sexes under ten years of age were affected. Between ten and nineteen years of age the number of cases of both sexes diminished. In the third decade, while the number of cases of males and females is practically the same, the available number of females is less.

III. Chart showing the percentage of total mortality by the two methods of treatment. The figures demonstrate that the intravenous method is the superior form of treatment for all ages, but its value was less apparent for cases from 20 to 29 and over 60 years of age.

IV. Chart showing the result of the two methods of treatment in collapse. The intravenous is shown to be the better for all ages, but its value is least apparent in the patients under 10 and over 60 years of age.

V. (In the text.) Apparatus for injecting normal saline solution.

VI. Chart showing the number of cases of uræmia after treatment by the intravenous method and the resulting mortality. Treatment was most effective between the ages of 20 to 29 and 40 to 49 years.

Fig. I.

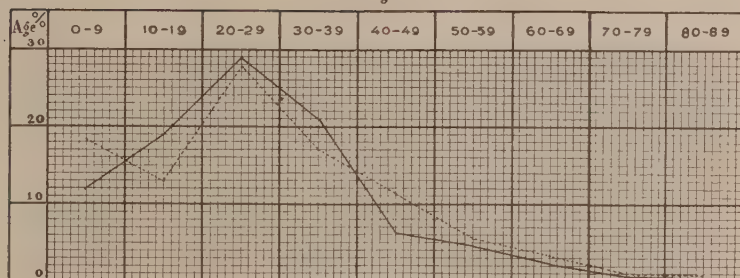


Chart 1. — % Population, Manila, Males.
 ----- % Cases of Cholera, Males.

Fig. II.

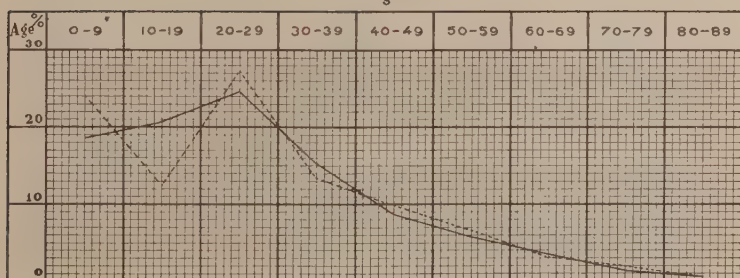


Chart 2. — % Population Manila, Females.
 ----- % Cases of Cholera, Females.

Fig. III.

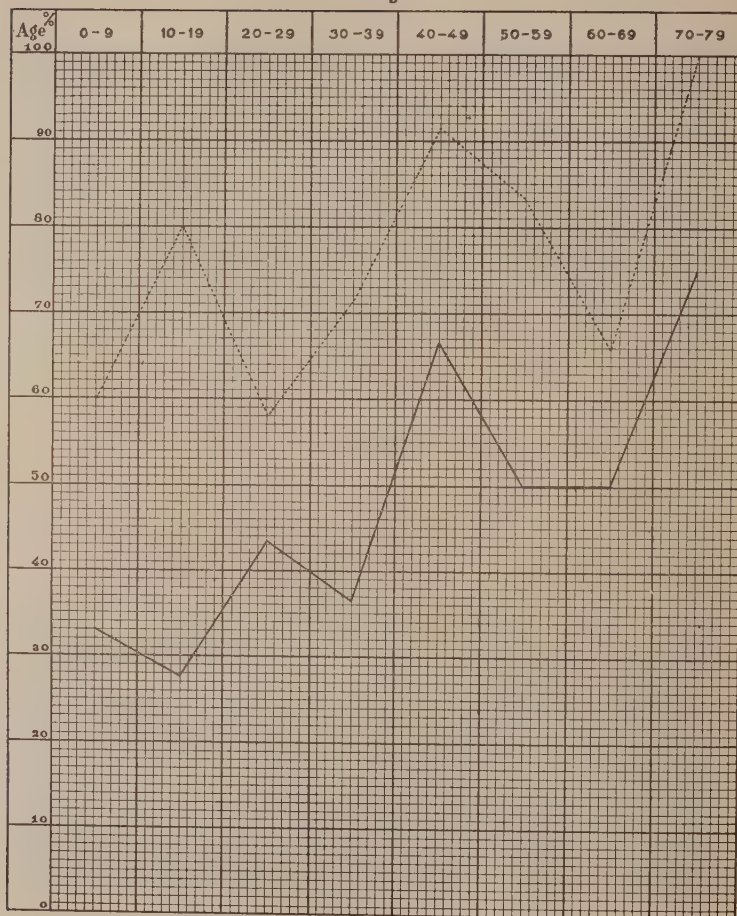


Chart 3. ----- % Mortality, Subcutaneous Injection.
———— % Mortality, Intravenous Injection.

Fig. IV.

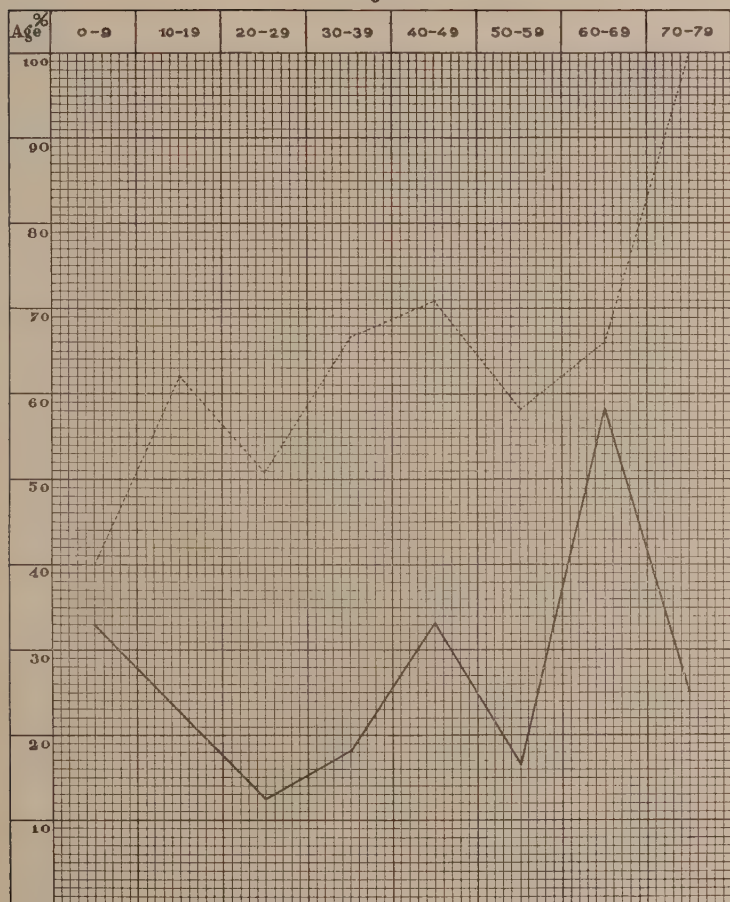


Chart 4 ——— % Age Mortality, Collapse, Intravenous Injection.
 ----- % " " " Subcutaneous "

Fig. VI.

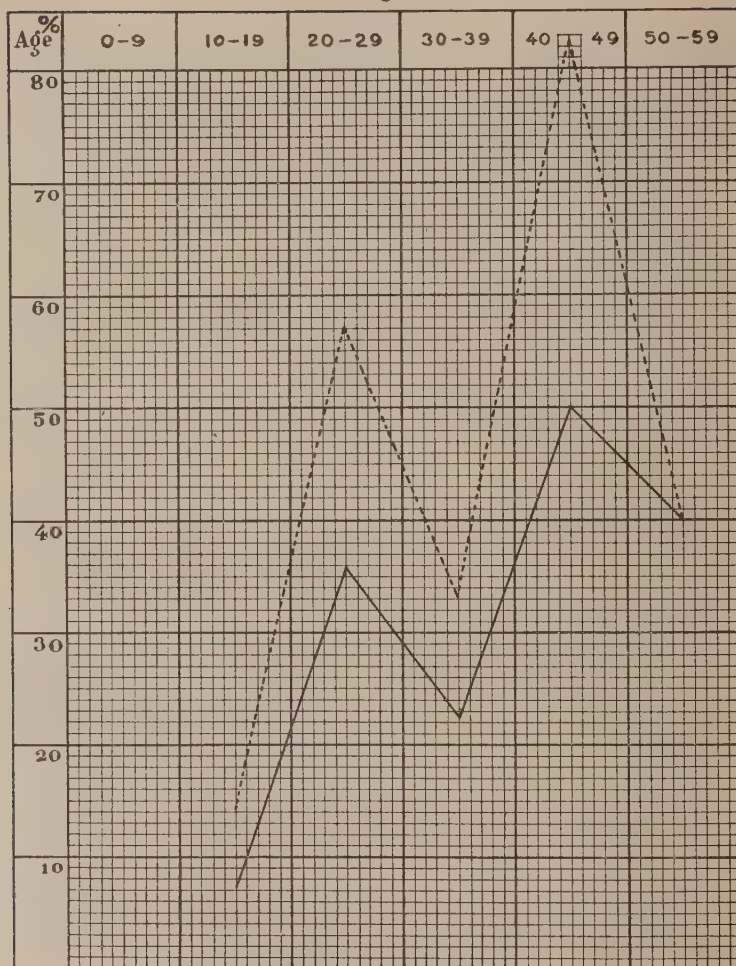


Chart 5 — Age % Mortality, uræmia, Intravenous Injection.
 " " Cases of " " " "

THE TREATMENT OF CHOLERA BY INJECTIONS OF HYPER- TONIC SALINE SOLUTIONS WITH A SIMPLE AND RAPID METHOD OF INTRAABDOMINAL ADMINISTRATION.¹

By LEONARD ROGERS.²

The abrupt onset and rapidity of the course of cholera make it an exceptionally difficult disease to treat efficiently. Indian statistics show that the recorded mortality has certainly not decreased with the advance of our knowledge of its causation through the discovery of the comma bacillus by Koch twenty-five years ago. Although Haffkine's preventative inoculation doubtless has a protective influence, it has not been found practicable to use it as a routine measure and it is now very little employed in India. No serum treatment has come into use, while a study of the writings of physicians from the time of the first great modern Indian outbreak in 1817, shows extremely little advance in the treatment by drugs or by other therapeutical agents during the last century.

RELATIONSHIP OF LOSS OF FLUID FROM THE BLOOD TO THE SEVERITY OF CHOLERA.

I have been studying the blood changes in cholera for some years past in the hope of obtaining thereby indications for a more definite line of treatment directed toward combating the actual pathological changes produced by the disease. It is well known that the blood becomes greatly concentrated, owing to the extensive drain of fluid from the body, yet as late as 1866 (and even in a book on nursing in the tropics, published last year), the evacuant treatment of cholera was advocated, in order to remove the toxins of the disease. Moreover it was strenuously denied that there is any relationship between the loss of fluid and the death rate. As Wall and others have pointed out, the effect of a given loss of fluid from the blood will depend as much on the rapidity as on the actual quantity of the loss. In order to estimate the actual degree of concentration of the blood in cholera, I have rapidly defibrinated and centrifuged it in a hæmocrite, the percentage of corpuscles and serum respectively being thus ascertained. As the corpuscles are not lost (except to a very small extent, in the rare hæmorrhagic cases), as

¹ Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, February 11, 1909.

² Professor of pathology, Medical College of Bengal, Calcutta, India.

many as 8,000,000 per cubic centimeter repeatedly having been found by me, the amount of serum which has been drained from the blood can be estimated by a simple calculation. Working in this way I obtained the following results in a successive series of cases treated by the method described below. The average loss of serum in the most severe class of cases, which comprised those which proved fatal in spite of intravenous transfusion, amounted to no less than 64 per cent of the total. In the cases requiring transfusion, but who recovered, the loss was 52 per cent. In the mildest cases, who recovered without transfusion, it averaged only 35 per cent. There was thus a most definite relationship between the loss of serum from the blood, with its corresponding concentration, and the severity of the disease. If we take the blood as one-thirteenth of the body weight, and the volume of serum of these Bengali patients as 55 per cent, then in the fatal cases no less than 42 of the total 66 ounces of serum were on the average lost from the circulating blood alone, in addition to the great drain from all the tissues of the body. Further, in the second class of recoveries after transfusion, the loss averaged 34 ounces. Such great losses of fluid, accompanied by a corresponding degree of concentration of the blood, must necessarily greatly embarrass the circulation, evidence of which is so clearly seen in the cold and blue extremities. In the severer cases the blood is so thick that it will not run into the capillary tube of a hæmocrite without the aid of suction, so that its passage through the minute vessels of the pulmonary and systemic circulations must be very difficult. Moreover, as long as this condition of the blood remains, and the exceedingly low blood pressure of 50 millimeters and less exists in severe cholera, there is no possibility of renal secretion, and on this the system is mainly dependent for the removal of the toxins. All these observations point to the replacement of the lost fluid as the primary consideration in the treatment of the collapse stage of cholera.

THE PROPORTION OF SALTS IN THE BLOOD IN CHOLERA.

At first sight it might be expected that the loss of such large quantities of fluid would be associated with an increase in the percentage of salts in the circulating blood, and that this condition might act as a conservative process by producing osmotic currents carrying fluid into the blood rather than from it. In this manner it would check the further escape of the fluid through the bowel wall, a process which manifests itself in the form of a watery diarrhoea and one which becomes much less marked in the collapse stage. Further, intravenous transfusion of normal saline fluids, such as have been used in the treatment of the disease for the last eighty years, would reduce the excess of salines in the blood, and again restore the draining of fluid through the intestines. It is just this recurrence of the diarrhoea, commonly within a very few hours, or even immediately after such injections, which has led to the generally

acknowledged failure of this promising plan of treatment in materially reducing the death rate from cholera, in spite of the miraculous, but very temporary, improvement resulting from it.

I have also tried large and repeated intravenous injections of normal saline solution (1 drachm to the pint or 0.65 per cent NaCl) controlling the amounts injected by their effect in raising the blood pressure to about the normal, but with the same want of success which has baffled all previous workers on the same lines. It then occurred to me that the desideratum to be aimed at was to raise or maintain a high salt content in the circulating blood which might be effected by using hypertonic saline solution. On rapidly increasing the strength to double that formerly used (2 drachms of sodium chloride to the pint, or 1.35 per cent, to which 3 grains of calcium chloride may be added) a most gratifying degree of success was obtained. At the end of a year, in spite of epidemic prevalence, such as is usually accompanied by an exceptionally high mortality, the death rate at the Calcutta Medical College Hospital during 1908 has been reduced from an average of 61 per cent during the four previous years before transfusion was commonly employed to 32.5 per cent in 186 recent cases, or to barely one-half of the average death rate before hypertonic transfusion was used. In the course of the outbreak I have made a number of estimations of the total percentage of chlorides in the blood, with very instructive results. The patients were almost all Bengalis, in whom Captain D. McCay, Indian Medical Service, has shown that chlorides are higher than in Europeans, namely, nearly 1.0 per cent. This fact must be borne in mind in considering the results, which showed that in the worst cases of cholera, the chlorides of the blood are nearly always actually below the normal, having averaged only 0.79 in the fatal ones, and 0.9 in the recovering ones including those treated with hypertonic solutions. Further, if the chlorides are raised to 1.0 per cent or over, recovery from the collapse stage almost always ensues. In several cases less than 0.7 per cent was found, and in some of these the blood was actually commencing to hæmolyse, the serum after centrifuging being stained with dissolved hæmoglobin. In one instance hæmorrhages were also found in the mucous membrane of the cæcum at the post-mortem examination. On examining the blood immediately after raising the salt content by hypertonic transfusion, the serum was found to be quite clear. In the cases which proved fatal from collapse, in spite of transfusion, the chlorides after the injection were still below 1.0 per cent and this was true in all cases except one, an old man who apparently died of heart failure.

The great reduction of chlorides in the blood in the worst cases of cholera, is doubtless associated with the presence of these salts in considerable quantities in the rice water stools, as pointed out long ago by Edmund Parkes. I also have found them commonly to contain as much as 0.5 per cent of chlorides and sometimes even more.

The above observations show the imperative necessity of replacing the lost salts as well as the fluid, for in the severest cases of cholera over two-thirds of the chlorides have been lost from the blood, and presumably nearly a similar amount from the tissues. This can most rapidly be done by the use of hypertonic intravenous saline injections, although in mild cases, with still a fair pulse and infrequent stools, the solution may be administered by the bowel. The transfusions were carried out by Captain Maxwell Mackelvie, Indian Medical Service, to whom I am extremely indebted for trying my plan.³

QUANTITY OF FLUID REQUIRED.

By estimating the percentages of serum and corpuscles with the hæmocrite and taking the specific gravity of the blood, both before and after intravenous transfusion, the effect of the introduction of different quantities of saline solution, to replace the fluid already lost, can be ascertained. The object to be aimed at is to dilute the blood to at least its normal condition, or preferably a little below this, in order to allow for any later concentration caused by further diarrhoea, and to replace the fluid and salts lost from the tissues. In cases requiring transfusion my observations show that from three to four pints are required for this purpose; usually the larger amount is necessary. Occasionally the injection of still further quantities is indicated, but rarely at one time. The amounts above mentioned have occasionally to be repeated on the following day if diarrhoea has persisted, but this is not very often the case when hypertonic solutions have been employed. Rigors and a rise of temperature not infrequently follow the injections, but do not appear to be harmful. Such large amounts as three or four pints can not be given very conveniently subcutaneously in cholera, and if no pulse at all can be felt at the wrist, they are sometimes not absorbed. Moreover, with the utmost care abscesses too often follow, owing to the great lowering of the vital resistance of the tissues in this disease. The intravenous injections require a fair amount of skill owing to the collapsed state of the vessels, while great watchfulness is necessary to avoid such dangers as the entry of air. Therefore under Indian conditions their use is frequently not feasible. Again, when the epidemic has appeared unexpectedly and has become widely prevalent it is generally impossible to find time to administer large intravenous injections to all the patients who require them since at least half an hour is necessary for each treatment. Under such circumstances a more simple and rapidly performed method of replacing the loss of fluid would render the use of hypertonic solutions a much more practicable and generally available life saving treatment in cholera.

³ *Indian Med. Gaz.*, (1908), 43, 165.

A SIMPLE METHOD OF TRANSFUSING SOLUTIONS INTO THE ABDOMINAL CAVITY.

The peritoneal sac affords a rapidly absorbing surface of wide dimensions, and one which would appear to be an ideal location for the introduction of the saline injections if the technical difficulties could be overcome, and the shock incidental to opening the cavity with a knife avoided. I have devised a simple form of canula which has been used in some thirty or forty cases at one of the Calcutta hospitals, with very satisfactory results. It consists of a steel tube about the size ordinarily used in paracentesis of the abdomen, and possesses a flat circular flange to prevent its introduction for more than $1\frac{1}{2}$ inches. The end is sharpened like a cork borer and is inserted into a narrow incision made through the skin and fascia. The instrument is bored through the remaining portion of the abdominal wall with fairly firm pressure, a finger preventing a sudden slipping in of the instrument to any great depth. The incision is made about half an inch below the navel where the peritoneum is adherent, and will not strip before it. It has been found impossible to perforate or otherwise injure the bowel with this instrument, while by attaching a sterile bulb and rubber tube to the external end, saline solution to the amount of 3 or 4 pints can be run into the cavity within ten minutes or less. If the pulse of the patient can be detected at all the fluid is rapidly absorbed, while an immediate further material rise of blood pressure is obtained by applying an abdominal binder after the transfusion has been completed, care being taken not to embarrass the respiration. For example, $3\frac{1}{2}$ pints of hypertonic saline solution were run into the abdomen of a cholera patient with a blood pressure of only 15 millimeters. After the operation the pressure was found to have risen to 65 millimeters, while an abdominal binder further raised it to 73 millimeters. Three hours later the fluid was mostly absorbed, and the pressure was 88 millimeters, while on the following morning it had reached the normal (for a Bengali), of 100 millimeters. The specific gravity and proportion of serum in the blood had both returned to normal, and the patient was passing urine freely and doing well. He subsequently made an uninterrupted recovery, except for a rise of temperature, which was found to be due to malaria, and which rapidly fell under quinine treatment. This plan requires further testing, but it promises to be a valuable addition to the methods of introducing saline solutions into the circulation, while it should also prove valuable in shock produced from other cause than cholera. In both there is a good deal of vaso-motor paralysis, and consequent accumulation of blood in the portal system, which may be materially relieved by the pressure exerted by an elastic abdominal bandage after intraperitoneal transfusion. The same aseptic precautions are necessary as for intravenous or subcutaneous injections, but boiled tap water has been safely used for preparing the salt solutions used in Calcutta in the cholera cases.

DEFICIENT BLOOD PRESSURE AS THE PRINCIPAL CAUSE OF POST CHOLERAIC URÆMIA.

Now that the use of hypertonic saline injections enables the great majority of cholera cases to be tided over the very dangerous collapse stage of the disease, that common and deadly late complication, uræmia, has become relatively more important than ever. A comparative analysis of all the cases treated at the Calcutta Medical College Hospital in 1907, when transfusions were rarely given, and normal saline solution only used, with those during the year 1908 when hypertonic injections were employed, showed a slightly lower death rate from uræmia in the latter than in the former series, namely, 12.8 per cent against 13.2 per cent. Therefore it is clear that the strong saline solutions in no way predispose to a deficient action of the kidneys. A study of the microscopical changes in the kidneys of patients who had died of post-choleraic uræmia, led me to suspect an actual mechanical obstruction to the circulation through the organs, produced by the great effusion of blood into and around the tubules. In order to test this hypothesis I measured the height required to perfuse normal saline solution through the vessels, of the kidney removed at the post mortem examination. These experiments were carried on with healthy kidneys and with those removed from patients who had died of choleraic uræmia. The results were very striking, for whereas in normal organs a pressure of from 20 to 30 millimeters of mercury sufficed to run a good stream of saline solution through the organs, in the choleraic kidneys after death from uræmia one of 90 to 100 millimeters were necessary. In one case of death from pneumonia following cholera, the patient having succumbed about a week after the renal secretion had been reestablished, 30 millimeters pressure only was needed to pass the solution through the kidney, showing that it was only in the uræmic cases that the obstruction was present. I have therefore watched the blood pressure day by day after recovery from the collapse state of cholera with the following results: Out of ten cases of fatal uræmia subsequent to intravenous transfusion in five the pressure toward the end was not over 80 millimeters, in three not above 90 millimeters, while in only two did it reach only 100 millimeters and that was just after intravenous injections, two and five days, respectively, before death. Moreover fatal uræmia was commoner in cases which had not been transfused than in those which had been; although the former were much milder cases in whom the measure did not appear to be necessary, but in which the blood pressure usually rose only very slowly from the invariable low point during the acute stage of the disease. Again a remarkable recovery from apparently hopeless choleraic uræmia, with rapid stertorous breathing, followed the forcing up of the blood pressure to over 100 millimeters by hypodermic injections of adrenalin and digitalin.

There is, then, a very definite relationship between a continued low blood pressure and the supervention of uræmia after recovery from the acute stage of cholera, which affords most valuable indications for treatment of this justly dreaded complication. Uræmia is most frequent in two classes of cases, first in very acute ones admitted early in the disease, and second, in mild ones admitted more than 48 hours after its onset, whose treatment has been consequently neglected, and in which a low blood pressure has persisted for a long period of time.

CONCLUSIONS.

1. The severity of the cholera attack is in proportion to the loss of fluid and salts from the blood, which, in all but mild cases of the disease, it is desirable to replace.

2. This can best be done by the intravenous injection of about four pints of hypertonic salt solution, two drachms of sodium chloride to the pint, (1.35 per cent) being a suitable strength. The use of this solution has reduced the mortality during 1908 in the Calcutta Medical College Hospital by nearly one-half.

3. When time does not suffice and the staff of assistants is not sufficiently large for the regular administration of intravenous injections, the salt solution may be given intraperitoneally with great advantage by the simple method described above.

4. Post-choleraic uræmia is associated with deficient blood pressure, and should be treated by methods which raise the tension in the arterial system.

(For the discussion of this paper before the Philippine Islands Medical Association see p. 141.)

THE SUPPRESSION OF A CHOLERA OUTBREAK IN THE PROVINCES OF THE PHILIPPINE ISLANDS.¹

By ALLAN J. McLAUGHLIN.²

The measures necessary for the suppression of an outbreak of cholera in the provinces are simply the measures applicable for the suppression of cholera anywhere, with such modifications as may be necessary because of local conditions.

These measures naturally group themselves into general and local. Under the head of general measures, or measures calculated to prevent widespread dissemination from unknown sources of infection, must be placed:

1. The securing of a good water supply; or general measures to render the water supply safe.
2. Safe disposal of feces of the entire population.
3. House-to-house inspection.
4. General disinfection of large areas where the foci can not be located definitely.
5. Campaign of education.
6. Prohibition of certain food stuffs.
7. Enactment of necessary ordinances.

Under local measures, or measures directed toward preventing spread and eradicating infection from known foci of infection, are placed:

1. Early quarantine of house and inmates.
2. Disinfection of house and inmates.
3. Observation of contacts for five days.
4. Examination of stools of contacts.

GENERAL MEASURES.

1. WATER SUPPLY.

The best water supply for the small provincial towns and *barrios* is undoubtedly furnished by the artesian well. The sum of ₱150,000 was appropriated last year by the Insular Government of the Philippine

¹ Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, February 12, 1909.

² Passed assistant surgeon, U. S. P. H. and M. H. Service, assistant director of Health.

Islands and is now being expended in drilling artesian wells in the provinces which have suffered most from cholera.

The itineraries of the well-drilling outfits are made out according to the recommendations of the Bureau of Health. The object lesson given by the Insular Government in drilling artesian wells successfully has had its effect on some of the more progressive provinces and several provincial boards have bought or propose to buy well-drilling outfits for furnishing artesian well water wherever feasible within their provinces.

The water supply in the majority of the provincial towns and *barrios* is still derived from sources easily infected, such as rivers, streams, ponds, pools, and shallow wells. The best of these wells should be selected and the others closed. If the water of the wells selected is of doubtful quality, it may be treated with permanganate of potash or boiled, and then issued under guard, with an absolute prohibition of the use of water from any other source. If the water is taken from a river every effort should be made to prevent pollution of the stream. There should be absolute prohibition of bathing or washing of clothes in the stream, and the people should be advised to boil all water before using it.

2. DISPOSAL OF FÆCES.

The demonstration of the presence of bacilli carriers shows us that the defecations of the apparently healthy may be dangerous, so that we must not only dispose of in a sanitary manner the stools of those actually sick with cholera, but also make safe disposal of the stools of the entire population.

In large cities, with sewer systems and flush closets, this part of the problem is easy of solution, but in Manila, and to a greater extent in the provinces, it presents great difficulties because of the habits of the people and certain peculiarities of climate and topography.

The Philippine village and town are usually poor, and expensive systems of disposal of waste is out of the question. The simple pit, used as a closet, where the stools are covered by lime or fresh earth, is effective during the dry season, or, when situated on high ground, is satisfactory in the wet one. In low, marshy districts, during the rainy season, the pit is unsatisfactory, and a pail system, or some simple modification thereof, is probably most satisfactory. A disinfecting solution should be furnished householders and all persons required to deposit their dejections into this solution.

3. HOUSE-TO-HOUSE INSPECTION.

House-to-house inspection is very important and if carefully done the cases are discovered early and the house may be quarantined before contacts have had a chance to scatter. To be effective it should be done at least once daily.

4. GENERAL DISINFECTION OF LARGE AREAS.

General disinfection of large areas is necessary at times when scattered cases occur over a large area and the source of infection can not be definitely located. Such disinfection should include that of all closets or any substitute therefor, or any place suspected of being soiled or infected by faecal matter. It may include also disinfection of the hands of the people in the suspected area, and an effort should be made to induce them to wash their hands before eating.

5. CAMPAIGN OF EDUCATION.

The inculcation of cleanly habits among the people, and instruction as to how they should protect themselves from infection are very valuable general measures in the prophylaxis of cholera. The campaign is most effectively carried on in the schoolroom and from the pulpit. The medical officer who is able to secure in this work the coöperation of the local *padre* and school-teacher will be indeed fortunate. The Director of Education and the Archbishop of Manila have done everything in their power to secure the coöperation of their representatives in the provinces with the Bureau of Health. The cholera circular of the Bureau of Health is concise and explicit and contains all the necessary rules for protection against infection. The circular is printed in Spanish, English, and the principal native dialects.

6. THE PROHIBITION OF CERTAIN FOOD STUFFS.

The prohibition of certain native foods, fruits, and vegetables seems to be a useful measure, although there is some doubt as to the reason why such prohibition is beneficial. Some of these foods are very irritating and indigestible and may be only predisposing factors. All these prohibited foods may cause infection, as they are either eaten raw or long after cooking, and are handled by a people many of whom in epidemic times may be bacilli carriers and whose habits of personal hygiene are those of a semi-savage people who have not yet arrived at the refinement of using a knife, fork, or spoon at their meals, or the washing of their hands before eating.

7. ENACTMENT OF SANITARY ORDINANCES.

It will be necessary to induce the municipal board to pass necessary ordinances in order to place these general measures in force, if such ordinances do not already exist, and the accomplishment of this is an art in itself. I think the past grand master in the art of inducing municipal councils to pass and enforce sanitary ordinances in the Philippines is Medical Inspector Paul Clements of the Bureau of Health. An efficient and fearless justice of the peace is essential to see that the enforcement of the ordinances is real and to apply substantial fines to the offenders.

LOCAL MEASURES.

1. QUARANTINE OF THE INFECTED HOUSES.

A quarantine of an infected house to be effective must be placed early and maintained rigidly. The local police are usually worthless, and the best results are obtained by employing outsiders, preferably the Constabulary, who have no interests, "*parientes*" or "*amigos*" in the *barrio* and who will obey instructions implicitly.

2. DISINFECTION.

As the cases must remain and be cared for in the houses in which they are found, one room is first disinfected, and the patient placed therein with a person acting as nurse. Disinfecting solution is furnished for the treatment of excreta, and instruction in the care of the sick and in self-protection is given to those in attendance on the patient. The rest of the house and its contents are then disinfected by washing or by immersion of the articles in a disinfecting solution. The contacts are disinfected and isolated; they are held under observation for five days, and whenever possible their stools are examined for cholera vibrios.

When, through the apathy or incompetence of local officials, it becomes necessary for Insular officers to take charge of a cholera situation in a provincial town, they usually find that little, if any, effort has been made to carry out these two very important factors which are so successful in combating cholera.

The first two cases of cholera in the Mariquina Valley, during the present fiscal year, occurred in the municipality of Mariquina on the 30th of August, one of them dying on the same day of the attack and the other living until the next day. During the month of September, from the 11th to the 31st, a total of 61 cases and 48 deaths were reported from this town.

In Pasig, the disease broke out on the 2d of September, there being during the month 60 cases and 50 deaths.

In San Mateo, the disease appeared on the 7th of September, the total for the month being 46 cases and 40 deaths.

The outbreak was coincidental with the Manila epidemic, but nevertheless men were sent from Manila to organize the available force and to direct operations. Sanitary Inspector Percy was detailed for duty in the Mariquina Valley from September 19 to October 20; medical inspector Vicente de Jesus from September 20 to October 24; and Sanitary Inspector Palmer from October 18 to October 30.

Troops were sent to Mariquina to protect the water supply of the city of Manila and remained on duty until the water from the new water system was turned into the mains.

Permission was granted for the withdrawal of the troops guarding the

river and the removal of the pail system installed by the city of Manila, when the inauguration of the new water system rendered these precautions unnecessary for the protection of the Manila water supply. The provincial and municipal authorities were urged to provide an efficient substitute for the pail system removed from Mariquina. This they failed to do.

When left to themselves, there is no doubt that the local authorities, with one or two remarkable exceptions, relapsed into their habitual apathy. The president of the sanitary department of Mariquina, Vicente Mallori, and the justice of peace of the same town, did probably all that two individuals could do without support from the other municipal officials.

As a result of the work of organization done by Dr. Jesus and Sanitary Inspectors Percy and Palmer, and the campaign carried on under their direction, cholera disappeared from the valley by November 16. The entire district was free from cholera from November 16 to December 12, when one case occurred in San Mateo. This was followed by a reappearance of the disease on the 14th in Mariquina, and in Pasig on the 21st, the total for the valley for the month of December being 87 cases with 77 deaths.

Medical Inspector Laughlin, late in December, made an inspection of Pasig and other towns and attempted to stir the local officials into activity. On December 29 and 30, Medical Inspector Clements made an inspection of the entire valley and did some strenuous work exhorting the municipal councils to action. On December 31 the writer, after a careful inspection of Pasig, Mariquina, San Mateo, and Montalban, decided that the local authorities were unable to cope with the situation quickly and placed the following organization at work on January 1, 1909. All of the men employed belonged to the regular Manila force:

Pasig: Sanitary Inspector Hogle in charge; 10 assistant sanitary inspectors; 1 disinfecter.

Mariquina: Sanitary Inspector Pauly in charge; Sanitary Inspector Jacobsen; 10 assistant sanitary inspectors; 1 disinfecter.

San Mateo and Montalban: Sanitary Inspector Percy in charge; 10 assistant sanitary inspectors; 1 disinfecter.

Daily inspection of the entire valley was made by Medical Inspector Paul Clements, and inspection three times per week by the writer.

On the 3d of January, upon request of the writer, the Governor-General ordered two companies of Constabulary to assist in this work. They were available for duty on January 5. The campaign was directed along the lines of our work in Manila in the recent epidemic, recognizing that the cardinal principle in fighting cholera is the proper disposition of the faeces of the entire population. Every householder in Pasig, Mariquina, and San Mateo was compelled to keep his premises clean, to dig a pit

for the reception of faecal matter and to cover such faecal matter with lime or fresh earth. House-to-house inspection was made by the assistant sanitary inspectors in order that the cases might be found in the early stage of the disease, the cholera cases were immediately quarantined under Constabulary guard, and careful and thorough disinfection carried out. The Bureau of Health in this fifteen-day campaign not only furnished all personnel, but also furnished 15 tons of lime and several barrels of Jeye's fluid and carbolic acid for disinfection.

The rapid decrease in the number of cases a day is shown by the following table:

Town.	January.											
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Mariquina.....	3	2	3	3	4	2	1	0	1	1	1	0
San Mateo and Montalban.....	3	5	1	2	2	2	1	1	0	0	0	1
Pasig.....	1	0	2	1	1	0	1	1	0	0	1	0

These towns having been five days without a case of cholera the Manila force was withdrawn on January 16 and 17, 1909.

Totals for 3 towns for 15 days preceding advent of Insular officials, with municipal and provincial health officers in charge, December 17 to 31, 1908.		Totals for the same 3 towns for 15 days during which Insular officers had charge, January 1 to 15, 1909.	
Date.	Number of cases.	Date.	Number of cases.
December 17.....	1	January 1.....	7
December 18.....	0	January 2.....	7
December 19.....	4	January 3.....	6
December 20.....	6	January 4.....	6
December 21.....	4	January 5.....	7
December 22.....	2	January 6.....	4
December 23.....	10	January 7.....	3
December 24.....	6	January 8.....	2
December 25.....	5	January 9.....	1
December 26.....	7	January 10.....	1
December 27.....	9	January 11.....	2
December 28.....	12	January 12.....	1
December 29.....	7	January 13.....	0
December 30.....	4	January 14.....	0
December 31.....	4	January 15.....	0

The sudden reduction in cases after the Constabulary became available on January 5 will be noted, showing the effect of efficient quarantine of the infected houses.

In fifteen days the valley was practically cleared of cholera. The measures employed were of kindergarten simplicity. The local author-

ities and the district health officer were continually urged to take note of these measures, and it is hoped that their continuance will follow.

In view of the rapid reduction in the number of cases, there is sufficient local force, including sanitary inspectors, police, and other employees of the municipalities to carry on the work provided the municipal president, the other municipal officials, and the police do their duty.

The chief difficulty arises from the reluctance of municipal officials to prosecute "*parientes*" or "*amigos*." There is also no doubt that the average native policeman for the same reason makes a very inefficient quarantine guard or sanitary inspector; he hesitates or neglects to report infractions of health ordinances if the infractors are friends or relatives, and he usually permits friends or relatives to enter or leave infected houses when he is left alone in charge.

It was deemed advisable to remove the president of the municipal board of health of Pasig from office. This individual complied with instructions inasmuch as he disinfected the house and placed it under quarantine guard, but it was his practice to permit infected clothing, bedding, dishes, food and drink to be removed and he then disinfected the empty house. He permitted the contacts to escape and then placed his quarantine guard on the empty house, which he had just disinfected. This was not ignorance, but rather an exaggerated desire to please his friends or to avoid making enemies.

The success achieved in the towns of Mariquina, Pasig, and San Mateo was repeated later in January in Taytay and Binangonan, which towns are also in Rizal Province.

The course of the outbreak is best shown on the charts appended.

ILLUSTRATIONS.

- CHART 1. Diagram showing prevalence of cholera in Mariquina, San Mateo, Montalban, and Pasig, Rizal Province.
2. Diagram showing prevalence of cholera in Binangonan, Rizal Province.
 3. Diagram showing prevalence of cholera in Taytay, Rizal Province.

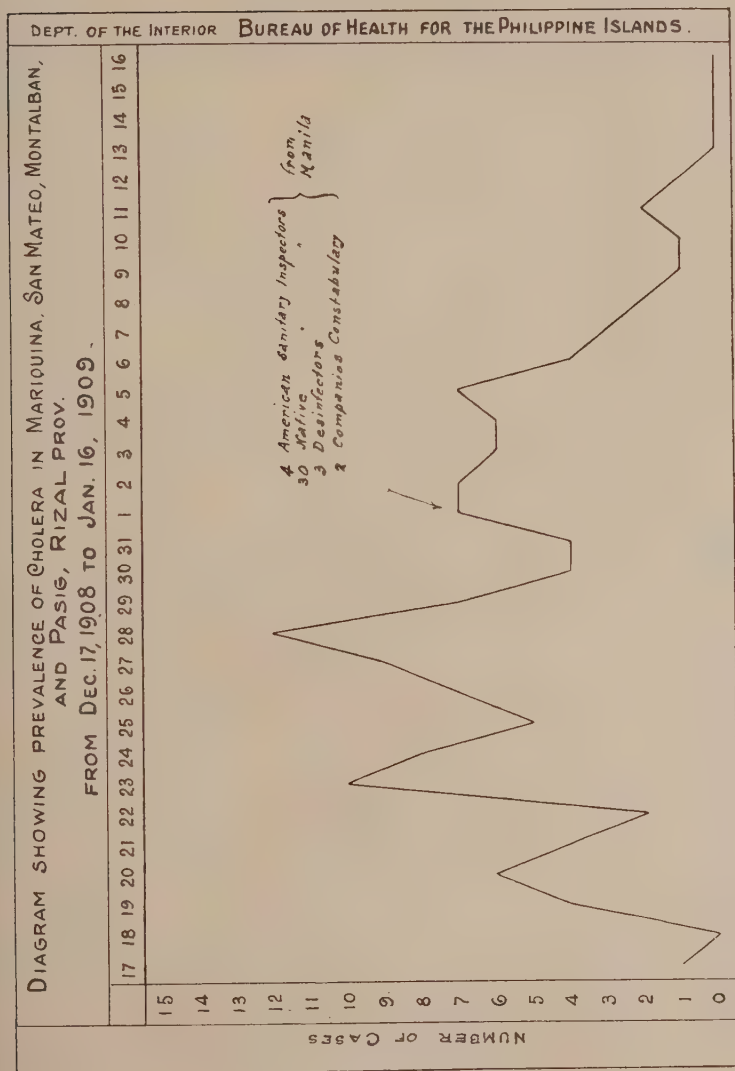


CHART 1.

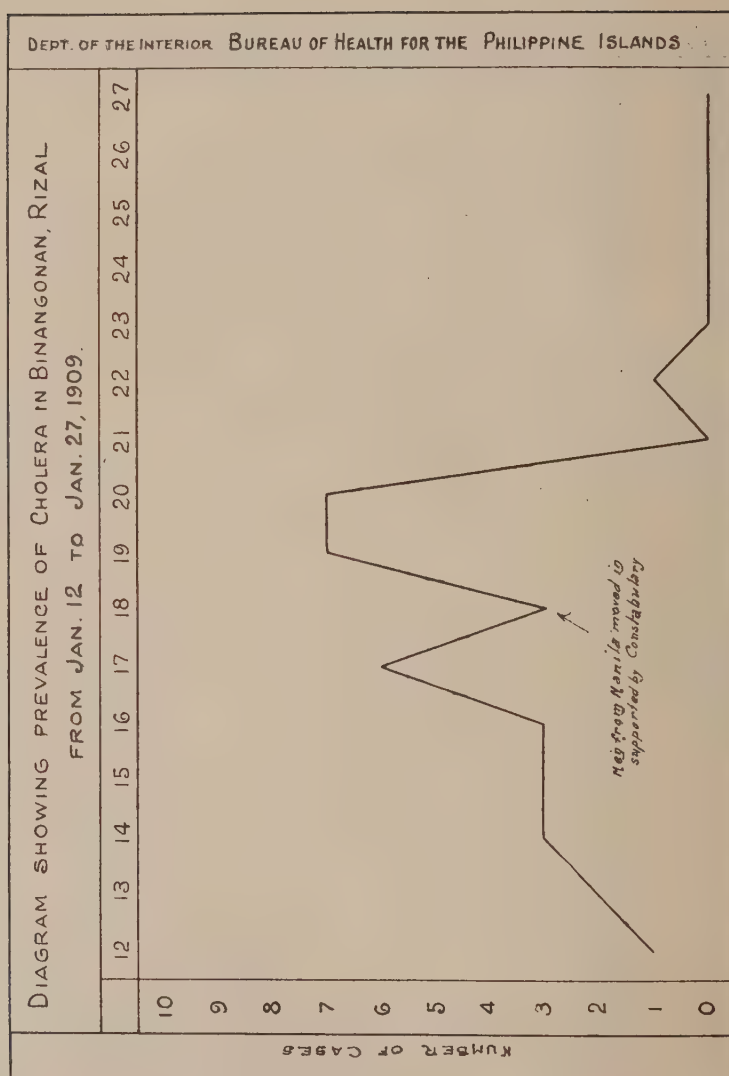


CHART 2.

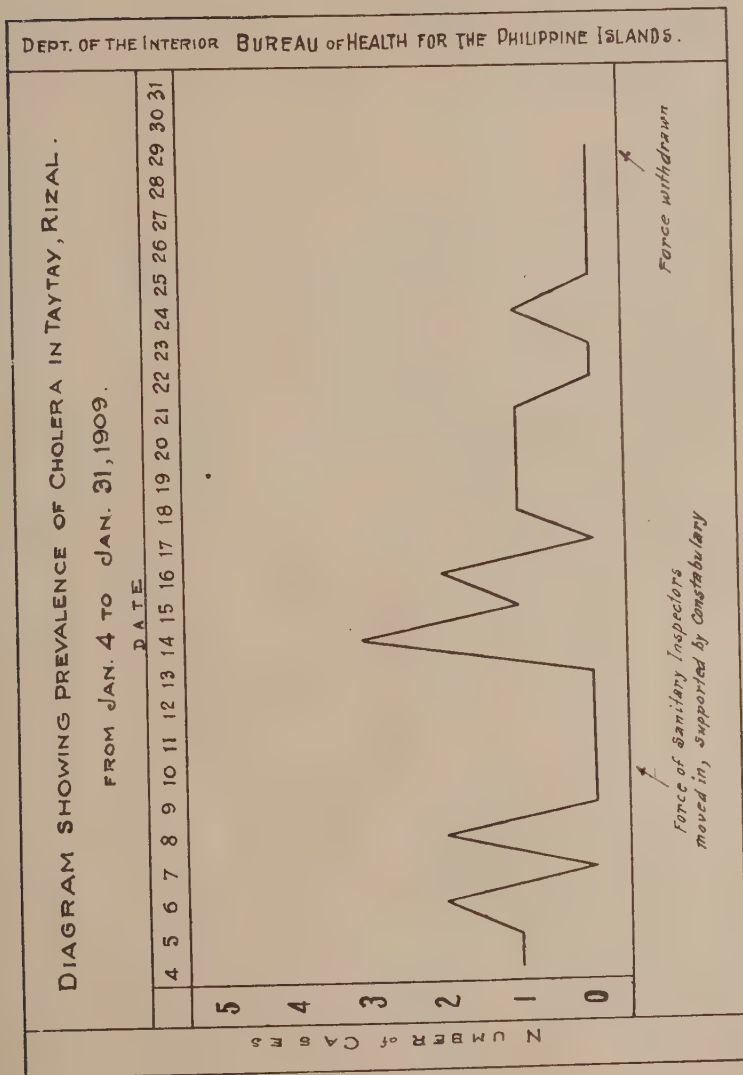


CHART 3.

REMARKS ON PIROPLASMOSIS.¹

By E. MARTINI.²

Theobald Smith was the first to recognize the real nature of *Piroplasmata*. He discovered the germ of Texas fever in the red blood cells of cattle in 1893 and called it *Pirosoma bigeminum* on account of its pearlike shape. Babes, a Roumanian, in 1888, had already observed similar organisms in the red blood cells of cattle, but he held them to be diplococci. Although these organisms are in no way related to bacteria, nevertheless, to Babes is given the priority of their discovery, especially by zoölogists, and the whole group is called after him *Babesia*; other observers, especially Laveran and Mesnil, inclining more to Theobald Smith's nomenclature, have adopted the name of *Piroplasma*.

The *Piroplasma bigeminum* which I shall describe fully as a type of the group is illustrated in Plate I, fig. 1. The organism is pear-shaped in outline and the body is double; the cytoplasm stains blue, and the chromatin-mass red. The whole parasite lies within a red blood cell. This parasite is transferred from animal to animal by means of ticks, and it weakens or even kills the host which it attacks through the destruction of enormous numbers of red blood cells, or in other words, by the severe anæmia which it produces.

It would take too long to give a full description of all the symptoms of the diseases to which *Piroplasmata* give rise, and in regard to the transmission of the diseases, I shall merely remark that only adult ticks, which have sucked the infected blood, or their young, are capable of transferring the disease from a sick to a healthy animal.

Since the discovery of *Piroplasma bigeminum* similar organisms have been sought for in all species of animals, not excepting man and in almost every part of the world. The *Piroplasma* of the horse and of the dog and the *Piroplasma* of Rhodesia fever in cattle, and others, all of similar morphology, have now been discovered. The last, name *Piroplasma parvum*, is extremely destructive to cattle, and was discovered by Koch in Rhodesia.

¹ Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, February 13, 1909.

² Surgeon major, Royal German Navy; detailed medical biologist to the Biological Laboratory, Bureau of Science, Manila, P. I.

In the case of infection with all of these parasites, ticks were demonstrated as the means of transmission of the disease from one animal to another. A recital of the names of the various species of ticks concerned in the transmission of the disease would be of little importance in the present discussion.

At least one, and perhaps more varieties of *Piroplasmata* exist in East Asia and I have been able to discover recently a *Piroplasma* in calves in Manila. The parasites lie within the red blood cells like other species of *Piroplasma*, generally they are rod-shaped or have the form of an arrow. It is seldom that they assume a ring shape. The chromatin-mass is quite distinct and sometimes two chromatin-masses can be seen; rarely four are visible. (Plate I, figs. 2 to 4.)

Such is the appearance of the *Piroplasmata* as they occur in the animal body. I am convinced that other important species of these parasites will be discovered in the near future.

The discovery of a *Trypanosoma* in human beings, which had been at first observed only in animals inspired a careful search for species of *Piroplasma* in man. And these attempts have also been successful. The cause of both typhus fever and of Rocky Mountain fever was first attributed to *Piroplasmata*; in both instances, unfortunately, a confirmation of these claims is wanting. Finally in 1903 a somewhat similar organism to the *Piroplasmata* was found in man. Leishman and Donovan, working entirely independently of each other, found the *Piroplasma* of *Kala-azar*, the one in smears made from a spleen at autopsy the other in material obtained by splenic puncture. Later, Homer Wright discovered the *Piroplasma* of tropical ulcer, which resembles that of *Kala-azar*. The *Piroplasma* of *Kala-azar* has received through Laveran the name of *Leishmani donovani*, which indicates that in his opinion this parasite belongs to a new group. Homer Wright has given the name of *Helcosoma tropicum* to the parasite which he discovered.

While the first mentioned *Piroplasma*, namely, *Pirosoma bigeminum* and *Piroplasma parvum* occur within the red blood cells, the human parasites just referred to are found in the leucocytes and macrophages. This is very evident in specimens made from the spleen of a case of *Kala-azar*.

Whereas ordinarily the leucocytes and macrophages act as phagocytes and destroy the microorganisms, in these instances the reverse is sometimes true and the parasites destroy the leucocytes and macrophages. Therefore, the name *Piroplasma leucocytophagum* might be an appropriate one for the group.

The suggestion to place these parasites, which are so different morphologically, in the same group with the *Pirosoma bigeminum* and *Piroplasma parvum* (the erythrocytophages), may seem at first surprising; however, some support for such an idea may be received from the fact that

intracellular parasites, such as the *Malaria plasmodia*, possess the biological faculty of changing the blood pigment into visible, amorphous particles, which faculty is entirely wanting in the *Piroplasma* group. I will not enter here upon a discussion of the relationship between these leucocytophages and the trypanosomes, an idea which has been suggested in a recent work, because this relationship at the present time is not quite clear.

For the present, the following species of parasites may be referred to one group:

(1) *Pirosoma bigeminum* aptly named by Theobald Smith on account of its pear-shaped, double body. The parasite is free from pigment, is situated in the red blood cells, and may be taken as a representative of the whole group.

(2) *Piroplasma parvum*.—This organism sometimes possesses a double body, but is not pear-shaped in outline; it likewise is free from pigment and is situated in the red blood cells.

(3) *Leishmani donovani* and *Helcosoma tropicum*, both of these parasites are also free from pigment and therefore are classified with the other two.

ILLUSTRATIONS.

PLATE I.

- FIG. 1. *Piroplasma bigeminum*.
2, 3, 4. *Piroplasma parvum*.



FIG. 1.

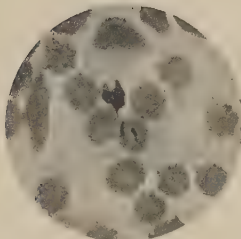


FIG. 2.

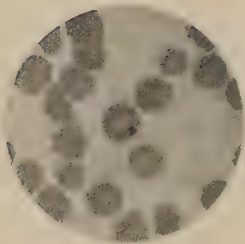


FIG. 3.

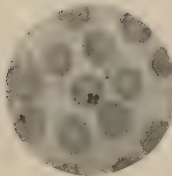


FIG. 4.

PLATE I.

THE DISTRIBUTION OF FILARIA IN THE PHILIPPINE ISLANDS.¹

By JAMES M. PHALEN and HENRY J. NICHOLS.²

- I. INTRODUCTION.
- II. MATERIAL.
- III. METHODS.
- IV. DISTRIBUTION.
- V. FILARIAL PARASITES OF MAN AND ANIMALS.
- VI. PRACTICAL CONSIDERATIONS.
- VII. CONCLUSIONS.

I. INTRODUCTION.

In a brief article published the previous year,³ the writers reported the result of a little over one thousand blood examinations for filaria, these examinations being made in various localities in Mindanao, Cebu, and Manila.

The investigations indicated that a small amount of filariasis was present throughout the Archipelago, and to form some adequate idea of its prevalence and distribution, the examinations thus commenced have been since continued.

The present paper is based upon nearly 6,400 examinations of as many subjects, with positive findings in 127 cases, showing nearly 2 per cent of infection for the Islands. The localities covered by these investigations include nearly the whole of Luzon, the principal islands of the Visayan group, the northern end of Mindoro, and scattered sections near the coast of Mindanao.

II. MATERIAL.

The enlisted personnel of the Philippine Scouts furnished 4,883 subjects for examination, the remaining number being made up of house servants and quartermaster employees at different military stations, inmates of provincial jails, and others from whom blood specimens could

¹ Read at the Sixth Annual Meeting of the Philippine Islands Medical Association, Manila, P. I., February 13, 1909.

² Captain, Medical Corps, United States Army, and first lieutenant, Medical Corps, United States Army, constituting the United States Army Board for the Study of Tropical Diseases, as They Occur in the Philippine Islands.

³ *This Journal*, Sec. B. (1908), 3, 305.

be obtained. It will thus be seen that the great majority of the subjects were adult males, and thus the results obtained from the examinations are not entirely representative of the entire population.

So far as sex is concerned, the error thus introduced is probably of little moment, as the occupations and habits, and therefore the opportunities for infection are much the same for the women of the Philippines, especially for the classes here considered, as for the men. Of the number examined by us 93 were women, of whom 3 were infected, indicating a percentage of infection among females of about the same as for the entire number of examinations. Of 35 subjects afflicted with elephantoid disease observed in the Provinces of Albay and Sorsogon, 14 were women.

With regard to age also the subjects were not entirely representative of the whole population. A very large majority of the persons examined were between 20 and 30 years. The filarial infection, once introduced, persists indefinitely, probably aided by frequent auto-inoculation in the presence of suitable mosquitoes. It is therefore reasonable to suppose that the number of such infections would be in nearly direct ratio to the age. In the subjects affected with elephantiasis, before mentioned, the average age at the incidence of the disease was about 35 years. Allowing then for a smaller number of infections in the young and a larger number in those of middle age and in older individuals, our subjects should represent a fair average of the general population.

The subjects examined are representative of the mass of the Filipino people, although the highest class is not represented and the lowest laboring class by but a very small number. Besides the Filipinos, several hundred Moros were included in the examinations and a few Chinese and Japanese residents.

The examinations have been made either by the writers or by medical officers of the Army at the several stations occupied by native troops, known as Philippine Scouts. Including American negro soldiers, a total of 6,804 cases have been examined for filaria; 3,447 by the Tropical Board, and 3,357 by medical officers as shown in the accompanying table (Table II). The findings given in each case have been confirmed by us.

III. METHODS.

The chief surgeon of the division issued a circular requesting either that an examination be made of the men of each command by the local medical officer or that suitable specimens be taken and forwarded to the Army Tropical Board for examination. The circular of instruction requested the examination of fresh specimens of blood taken after 9 o'clock

at night, or preferably the examination of dried specimens by the following method. Four large drops are placed close together near the center of the slide and they are then run together with a needle to form a thick smear of the size of a small, square cover-glass. The smear is allowed to dry in the air and may be examined at any time thereafter. When the smear is looked over, it is first placed face downward in a shallow dish of water, the ends of the slide supported upon glass rods. Within a few minutes, depending upon how long the smear has been kept, the haemoglobin will have become dissolved out of the smear, leaving a whitish film upon the slide. This is best examined with a low-power lens while still wet and without staining. The advantages of this method are that a much larger amount of blood is examined than if the fresh specimen is employed and that the examination may be made at any subsequent time. This is very important where a large number of persons are to be examined and when the specimens are taken at night. Then too, the smear can be run over very rapidly and with very little strain on the vision, the filarial embryo catching the eye as soon as it comes into the field. To one not familiar with the appearance of the embryo in such preparations, there are many objects, chiefly plant fibers, which may at a glance resemble filaria, but by observing them with a higher power lens, all doubt as to their nature will be removed. After having seen the filarial embryo once, the examiner will have no difficulty thereafter in recognizing it immediately with a low-power lens. Such preparations are of no value in determining the species of the parasite, the presence or absence of a sheath being about the only important point that can be determined from dried specimens. Having found the parasite by this method, the further study of it must be carried out with fresh specimens.

In our investigations only one examination of one blood specimen from each subject was made. On this account some slight infections with filaria may have been overlooked, but it is not thought that the number so missed could be very great. Among the large number of filarial cases that we have seen in the last year, there were not more than a half dozen in whose blood embryos could not be found in every specimen taken at night. In a large proportion 20 to 40 embryos per drop could be found, while in several instances the number reached well above a hundred.

IV. DISTRIBUTION.

The following table shows the geographical distribution of the parasite in the Islands. The Provinces of Luzon and Mindanao have been arranged in groups either on account of their proximity or on account of tribal affiliation of the inhabitants. For the rest of the Archipelago, the distribution is shown by islands.

TABLE I.—*Distribution of Filaria nocturna in the Philippine Islands.*

Source.	Number examined.	Infected.	
		Number.	Per cent.
Ilocanos (Ilocos Norte, Ilocos Sur, and Union)	1,019	6	0.58
Cagayanans (Cagayan, Isabela, Infanta, and Nueva Vizcaya)	394	1	0.26
Pangasinans (Pangasinan, Tarlac, Nueva Ecija, and Zambales)	374	0	0.0
Pampangans (including Macabebes)	1,140	1	0.088
Tagalogs (Bulacan, Rizal, Cavite, Laguna, Batangas, Tayabas, and Mindoro)	399	2	0.53
Tagalogs in Manila	292	13	4.4
Bicols (Ambos Camarines, Albay, and Sorsogon) ..	365	37	10.1
Inhabitants of—			
Bohol	27	2	7.4
Cebu	519	3	0.57
Leyte	253	20	7.8
Negros	131	2	1.5
Panay	536	4	0.74
Samar	141	4	2.8
Cotabato	390	4	1.3
Lanao and Misamis	191	9	4.7
Zamboanga	172	2	1.25
Davao		15	
Miscellaneous	41	0	0.0
Total	6,384	125	2

The percentage for the various localities can be seen more readily by reference to the accompanying map. The examinations classified as "miscellaneous" were mainly from the Province of Bataan and from the smaller islands, from which localities there were not enough examinations to warrant making an estimate of the percentage of infection. The district of Davao has been given tentatively a percentage of between 2 and 5. Three infections have been found among a small number of examinations and Captain Ames of the Constabulary service reported that he had found 12 cases in the course of his ordinary medical practice in three years.

As will be seen from the map, the greater part of Luzon and the populous Islands of Panay, Negros, and Cebu show an infection of less than 1 per cent; in most instances it is much less than this. Among over 50 cases of elephantoid disease of which we have definite records, only three lived within these regions. Filarial disease, therefore, is not an important one in this large area.

However, in southeastern Luzon, and the Islands of Samar, Leyte, and Bohol over 5 per cent of the population is infected, and in some localities fully 10 per cent. Forty of the cases of elephantiasis en-

countered live in these regions. Therefore, filarial disease must be considered of great importance in these portions of the Islands. The description of the character of southeastern Luzon, given in a previous paper, as a country of rugged outline, high rainfall and rank vegetation applies to Leyte and Samar, and these islands are in marked contrast to the comparatively bare and dry Island of Cebu lying near by.

Certain areas in Mindanao would seem to show a percentage of infection intermediate between these two extremes, but further work will be necessary to establish this definitely.

TABLE II.—*Examination of Philippine Scouts for filaria.*

No. of company.	Station.	Specimen taken by—	Examined by—	Number examined.	Number infected.	Tribe.
1	Los Baños -----	Capt. Boyer, M. C. ---	Tropical Board -----	101	0	Macabebe.
2	do -----	Capt. Persons, M. C. ---	do -----	108	0	Do.
3	do -----	Lieut. Reed, M. C. ---	do -----	109	0	Do.
4	do -----	do -----	do -----	108	2	Do.
5	Calapan, Mindoro ---	Lieut. Bierbower, M. R. C.	Lieut. Bierbower, M. R. C.	105	0	Do.
6	Macabebe, Pampanga.	Lieut. Clayton, M. R. C.	Lieut. Clayton, M. R. C.	100	0	Do.
7	Camp Avery, Corregidor.	Capt. Woodall, M. C.	Capt. Woodall, M. C.	82	0	Do.
8	Cotabato, Mindanao.	Tropical Board -----	Tropical Board -----	85	0	Do.
9	do -----	Maj. Fuller, M. C. ---	Maj. Fuller, M. C. ---	110	0	Do.
10	Fort Pikit, Mindanao.	Lieut. Delacroix, M. R. C.	Lieut. Delacroix, M. R. C.	46	0	Do.
11	Cotabato, Mindanao.	Maj. Fuller, M. C. ---	Maj. Fuller, M. C. ---	110	0	Do.
12	Camp Avery, Corregidor.	Capt. Woodall, M. C.	Capt. Woodall, M. C.	105	0	Ilocano.
13	Camp Gregg, Pangasinan.	Capt. Brechemin, M. C.	Capt. Brechemin, M. C.	95	0	Do.
14	Camp Wilhelm, Tayabas.	Capt. Powell, M. C. ---	Capt. Powell, M. C. ---	87	1	Do.
15	Camp Overton, Mindanao.	Maj. Shimer, M. C. ---	Maj. Shimer, M. C. ---	114	0	Do.
16	Camp Gregg, Pangasinan.	Capt. Brechemin, M. C.	Capt. Brechemin, M. C.	91	0	Do.
17	Gandara, Samar -----	Lieut. Kellogg, M. R. C.	Lieut. Kellogg, M. R. C.	104	0	Do.
18	Calapan, Mindoro ---	Lieut. Bierbower, M. R. C.	Lieut. Bierbower, M. R. C.	87	1	Do.
19	Camp Wilhelm, Tayabas.	Capt. Powell, M. C. ---	Capt. Powell, M. C. ---	87	0	Do.
20	Camp Connell, Samar.	Lieut. McLeod, M. R. C.	Lieut. McLeod, M. R. C.	113	1	Do.
21	Camp Gregg, Pangasinan.	Capt. Brechemin, M. C.	Capt. Brechemin, M. C.	95	0	Do.

TABLE II.—*Examination of Philippine Scouts for filaria*—Continued.

No. of company.	Station.	Specimen taken by—	Examined by—	Number examined.	Number infected.	Tribe.
22	Camp Connell, Samar.	Capt. Ekwurzel, M. C.	Capt. Ekwurzel, M. C.	100	0	Ilocano.
23	do	do	do	100	2	Do.
24	Camp Gregg, Pangasinan.	Capt. Brechemin, M. C.	Capt. Brechemin, M. C.	99	0	Do.
25	Camp Avery, Corregidor.	Capt. Woodall, M. C.	Tropical Board	97	1	Cagayano.
26	do	do	Capt. Woodall, M. C.	96	1	Do.
27	Atimonan, Tayabas	Lieut. Hall, M. R. C.	Lieut. Hall, M. R. C.	102	0	Do.
28	Camp Avery, Corregidor.	Tropical Board	Tropical Board	105	2	Do.
29	Imus	Capt. Metcalfe, M. C.	do	88	1	Tagalog.
30	do	do	do	73	1	Do.
31	do	do	do	87	1	Do.
32	Infanta, Tayabas	Lieut. Warriner, M. R. C.	do	93	9	Bicol.
33	Nasugbu, Batangas.	Lieut. Patterson, M. R. C.	Lieut. Patterson, M. R. C.	107	6	Do.
34	Imus	Capt. Metcalfe, M. C.	Tropical Board	70	1	Tagalog.
35	Abuyog, Leyte.	Lieut. Stallman, M. R. C.	Lieut. Stallman, M. R. C.	108	8	Visayan.
36	Tagabiran, Samar	Lieut. Hadra, M. R. C.	Lieut. Hadra, M. R. C.	75	0	Do.
37	Camp Hayt, Samar	Lieut. Eliot, M. R. C.	Lieut. Eliot, M. R. C.	90	1	Do.
38	Naga, Cebu	Tropical Board	Tropical Board	108	4	Do.
39	Tanuan, Leyte	Lieut. Dougherty, M. R. C.	do	100	5	Do.
40	Palawan	Lieut. Bowman, M. R. C.	Lieut. Bowman, M. R. C.	114	0	Do.
41	Tolosa, Leyte	Lieut. Sabin, M. R. C.	Tropical Board	107	2	Do.
42	Cotabato, Mindanao.	Lieut. Love, M. C.	Lieut. Love, M. C.	73	2	Do.
43	Borongan, Samar	Lieut. Tetrault, M. R. C.	Lieut. Tetrault, M. R. C.	107	4	Do.
44	Tagabiran, Samar	Lieut. Hadra, M. R. C.	Lieut. Hadra, M. R. C.	109	0	Do.
45	Cudarangan, Mindanao.	Tropical Board	Tropical Board	92	4	Do.
46	Margosatubig, Mindanao.	Lieut. Jordan, M. R. C.	Lieut. Jordan, M. R. C.	100	0	Do.
47	Danao, Cebu	Lieut. Davis, M. R. C.	Lieut. Davis, M. R. C.	102	0	Do.
48	Borongan, Samar	Lieut. Tetrault, M. R. C.	Lieut. Tetrault, M. R. C.	107	0	Do.
49	Camp Hayt, Samar	Lieut. Eliot, M. R. C.	Lieut. Eliot, M. R. C.	95	3	Do.
50	Balamban, Cebu	Lieut. Phillips, M. C.	Lieut. Phillips, M. C.	102	1	Do.
(*)	Fort McKinley	Maj. Rand, M. C.	Maj. Rand, M. C.	40	0	
Total				4,883	64	

* Band men.

Grouped according to races the number of examinations and infections are shown in the following table:

TABLE III.—*Racial infection with filaria.*

Race.	Examinations.	Cases.	Per cent.
Filipino	6,035	118	1.9
Moro	384	5	1.7
Japanese	39	1	-----
Chinese	26	1	-----
American negro	420	2	-----
Total	6,804	127	-----

The negroes examined were soldiers, and are not included in the first table. They had all been serving in the Cotobato district of Mindanao for a little over a year before the examinations were made. One of the two found infected was from Charleston, South Carolina, where cases of filariasis are occasionally seen, and the other from Porto Rico where the disease is rife. Therefore, the question as to where these two men were residing when they became infected must be considered doubtful. However, the Porto Rican had been in the Philippine Islands only 5 months when the parasite was found, and the two men had been in the same company for two years; it is possible, therefore, that the Porto Rican was infected in his own country and later was the source of infection of the other case.

V. THE FILARIAL PARASITES OF MAN AND ANIMALS.

Only a small number of the cases seen or reported have been studied with a view to the identification of the parasite. Such as we have studied, however, have shown embryos fulfilling the requirements of the microfilaria Bancrofti, perhaps more widely known as the *Filaria nocturna*. No specimen of the adult worm has been seen, so that identification has been made wholly by means of the embryo. No example of the *Filaria philippinensis* of Ashburn and Craig has been observed. From the southern islands medical officers of the Army have reported a microfilaria without a sheath and with apparently diurnal periodicity, but these observations have not been verified.

Of the filaria of the lower animals, the *Filaria immitis* of the dog and a filaria analogous to the *Filaria loa* of man, but parasitic in the horse, are known to occur here. Dr. Bishop, of the Manila city stables, reported having seen the *Filaria immitis* in two wolves dying at the zoölogical garden, and Dr. Love of the Army saw a case in a house dog at Jolo.

The writers recently made post-mortem examinations of twenty-two dogs at the city pound and found one dog with his right heart filled with adult worms, while the lungs contained very numerous embryos. The filaria of the horse, probably *Filaria papillosa*, has been reported from several places in the Provinces of La Laguna and Batangas. It may be observed swimming around in the fluid of the anterior chamber of the eye, and can usually be easily extracted. Dr. Thompson of the Alabang stock farm has recently observed two such cases. A trip was made to the farm for the purpose of securing a specimen, but the parasite had retired into the posterior chamber of the eye, and could not be discovered.

VI. PRACTICAL CONSIDERATIONS.

Since filariasis possesses such disastrous potentialities, it should be incumbent upon us to take precautions against it, especially in sections where it is known to be most prevalent. These precautions are not difficult, and as the protection from mosquitoes is one of the prime requisites, and is a matter quite as much of comfort as of safety, this measure is usually fairly well carried out. The other measure, also very easy, is the examination at night of the blood of the house-servants for the parasite, and the prompt discharge of any that are found infected. No consideration should suffice to keep a subject harboring filariæ about the house of an American or European. Any measure of protection for the mass of the Filipino people must be hopeless, unless possibly a mosquito crusade covering the whole Islands were undertaken, but the energy of such crusades is usually too quickly dissipated to avail much against such a persistent disease.

The investigation of the Philippine Scouts will probably result in the discharge of the infected individuals, and the examination of the blood for filaria, of applicants from areas which have shown a high percentage of infection, required as a part of the examination for enlistment in that branch of the Army.

VII. CONCLUSIONS.

Many writers have spoken of the irregular, often erratic, distribution of filariasis. Scheube⁴ speaks of the small, narrowly circumscribed centers to which the disease is frequently confined even in tropical countries, and this despite the fact that the surrounding regions present to all appearances exactly similar conditions.

The valley of the Kinali River in Albay seems to present some such endemic center, although the whole surrounding country appears to be infected to a lesser extent. There are probably other small centers in Samar, Leyte, and Mindanao. A local distribution of the filaria-carrying

⁴ Diseases of warm countries (1892), 389.

mosquito would be the first explanation of this phenomenon that would suggest itself, but the demonstration of the ability of the omnipresent *Culex fatigans* Wied. to transmit the disease renders this theory improbable. An explanation of this erratic distribution is furnished by Wanhill⁵ from Jamaica, which island is said to be free from filariasis. He says that while Jamaica has no filariasis it is highly malarious, while the neighboring Island of Barbados which has no malaria shows a high percentage of filarial infections. From these facts and observations upon a subject of filariasis, who later developed malaria, he evolved a theory of an antagonism between the malarial and the filarial parasite. The hypothesis is interesting at least, and as no better explanation is at hand, it might be well to look into the frequency of malaria in the filarial centers of these Islands, and if the observations of Wanhill were confirmed, experimental work might possibly give us a biological remedy in filariasis where drugs have proved entirely unavailing.

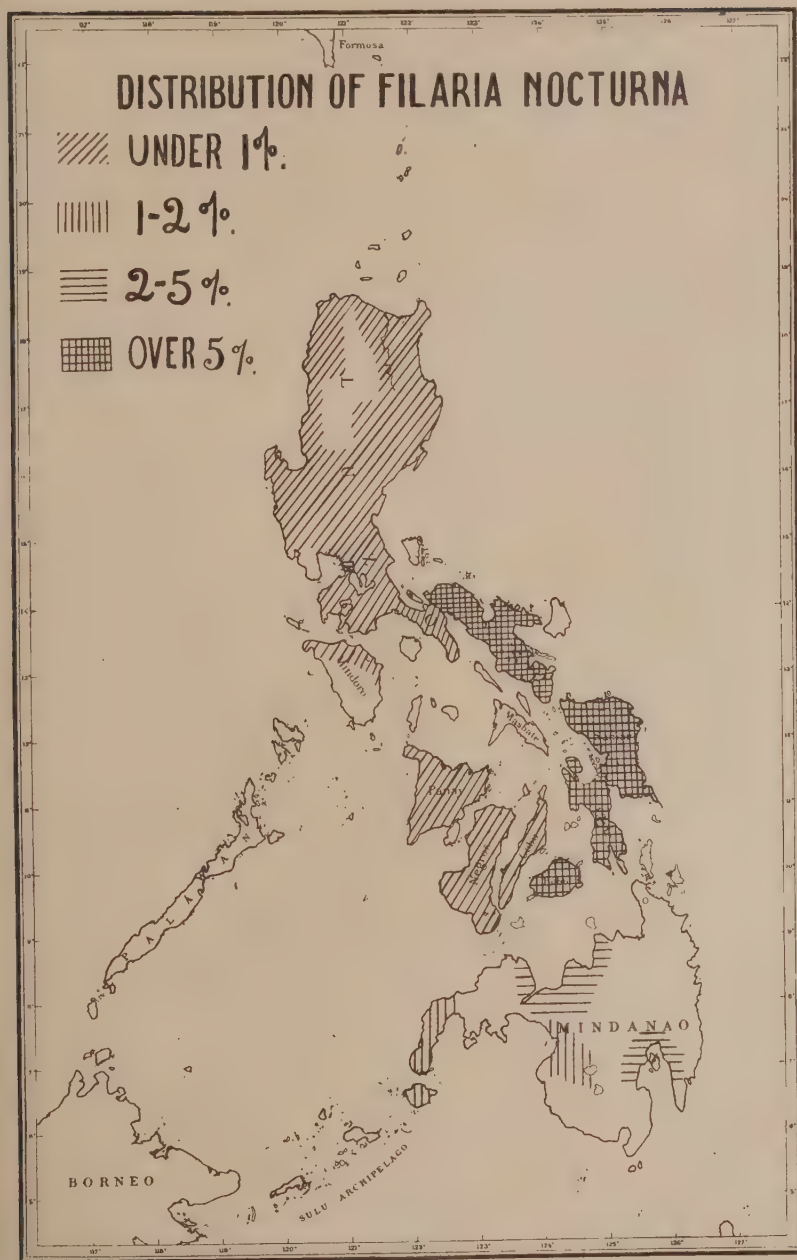
SUPPLEMENTARY NOTE.—Since the presentation of this paper, examinations have been made of the blood of 250 American soldiers of the Twenty-sixth Infantry, who have been stationed for eighteen months at Camp Darago, Albay, in the most highly infected filarial district of the Islands. Contrary to expectation, no case of infection was found. This result would seem to indicate that, with ordinary precautions, protection of white people from filariasis is not a difficult matter.

⁵ Journ. Roy. Army Med. Corps (1906), 6, 561.

ILLUSTRATION.

MAP 1. Distribution of *Filaria nocturna*.

137



EDITORIAL.

DISCUSSIONS OF THE PAPERS OF MR. CLEGG AND OF DRS. ROGERS, AND NICHOLS AND ANDREWS.¹

Dr. Oscar Teague, assistant, Biological Laboratory, Bureau of Science: I have had the pleasure of following Mr. Clegg's work from day to day and feel convinced that the acid-fast bacillus which he has placed under the microscopes for demonstration is really undergoing multiplication on his amœba-plates. The fact that acid-fast bacilli are rare in the intestine renders it unlikely that the bacillus in question is a contamination which wandered from the intestine by way of the blood into the spleen. As mentioned by Mr. Clegg the cultivation of an acid-fast organism of similar morphology from the spleen of a second case, and the failure to find this organism in control plates furnish additional evidence against contamination.

Dr. R. P. Strong, chief Biological Laboratory, Bureau of Science, Manila, P. I., and professor of tropical medicine: I have had, of course, an opportunity to observe carefully Mr. Clegg's work. As most of you are aware, we have no definite means of identifying the leprosy bacillus outside of the human body. The morphology and the staining reactions of this organism are the most definite features in its recognition. Its failure to multiply on artificial media has also been regarded as an important means of differentiating it from *Bacillus tuberculosis*.

Although very numerous attempts have been made to cultivate the *Bacillus lepræ* on artificial media, and a number of successful reports of such cultivations have been made, I think we are justified in saying that up to the present time no satisfactory means of its cultivation has been discovered. However, no one before has reported any attempt to cultivate the leprosy bacillus in symbiosis with amœbæ. This is a new idea, and while it is still too early to speak with absolute certainty, yet it would appear that Mr. Clegg has been successful in cultivating this organism.

It is true that after a few transplants of his cultures the morphology of the acid-fast organism does not resemble closely in morphology the leprosy bacillus as we see it in the human lesions. But as Mr. Clegg

¹Held before the Sixth Annual Meeting of the Philippine Islands Medical Association, February 11, 1909.

has pointed out, we know nothing as yet of the morphology of the leprosy bacillus on artificial media. However, it must be admitted that the changes in morphology between the organism he has cultivated and the leprosy bacillus as seen in the lesions are greater than those seen between the tubercle bacillus as it occurs in the tissues and in sputum, and in cultures.

In order for us definitely to be sure that the acid-fast organism which he has cultivated is *Bacillus lepræ*, these experiments must be repeated many times with different strains of amœbæ and with numerous cases of leprosy.

Inoculations of animals with the organism will probably throw little light on the subject, for while it has been occasionally possible upon subcutaneous inoculation of the leprosy bacillus into monkeys, to cause it to multiply slightly, a fact recently called attention to by Nicolle and confirmed by Mr. Clegg in some of his early experiments, the results of such inoculations are too uncertain and the lesions produced too indefinite for them to be of much value in the identification of the organism.

It would appear that Mr. Clegg has actually cultivated the leprosy bacillus, but even if it should be shown in his further experiments that this is not the case, his discovery will nevertheless be of importance, since, if the organism is not really *Bacillus lepræ*, it is evidently a hitherto undiscovered one.

Mr. Lindquist of Manila, P. I.: During the past week I have isolated from the stools of a child an acid-fast bacillus which can be cultivated on agar. I have just obtained a pure culture of this organism and I will be glad to send the culture to Dr. Strong.

Dr. Victor G. Heiser, Director of the Bureau of Health, professor of hygiene, and passed assistant surgeon, Public Health and Marine-Hospital Service: I was particularly interested in the treatment discussed by Dr. Rogers, and will give his method a trial at the San Lazaro Cholera Hospital as soon as the opportunity offers. The figures were very striking, but further confirmation seems highly desirable.

A representative from the Pasteur Institute came here a few years ago who had treated with a cholera serum about 30 cases of cholera in Saigon without a single death, but here the use of the serum at the San Lazaro Hospital administered by himself, proved to be no more efficacious than the routine treatment.

Dr. Strong: I was also very much interested in Major Rogers's paper, and I thoroughly agree with him that the replacement of the lost fluid must be the primary consideration in the treatment of the collapse-stage of Asiatic cholera. Gärtner and Beck in 1893 after experiments upon dogs and rabbits, suggested the employment of a hypertonic solution of sodium chloride by intravenous injection, for the treatment of Asiatic cholera in order to prevent exudation from the blood into the intestinal

canal and the further concentration of the blood. They thought perhaps that a reabsorption of fluid might even take place from the intestine and they were able to show in their animal experiments that such a reabsorption did take place. Rumpf tried this method of treatment in cholera, but did not obtain any more favorable results with it than with that in which normal salt solution was employed.

There is no doubt that the specific gravity of the blood is higher than normal in the severe cases of Asiatic cholera, as has been shown by numerous careful examinations. This concentration of the blood is due to the loss of water; the organic constituents are thereby increased.

Biernacki showed that both the leucocytes and red blood corpuscles were increased in number, owing to the loss of fluid from the blood; the latter numbering from 6 to 8 million in severe cases. The salts of the blood pass into the intestines together with the water. A number of chemical analyses of the blood in cholera made by Schmidt showed a moderate decrease in the sodium chloride and an increase in the potassium salts in the concentrated blood. Schmidt's analyses were made in 1850 and no careful chemical study of the blood in cholera appears to have been made since. Dr. Aron of our laboratory has recently begun some chemical analyses of this nature. I believe that the increase in the specific gravity of the blood in cholera is due largely to the increase in the organic constituents and is not affected much by the decrease in the amount of salts. If it is advantageous to increase the amount of sodium chloride in the blood in cholera cases beyond the normal, it would seem that theoretically we have a basis for using the injections of hypertonic saline solution as recommended by Major Rogers, however from the experiments of Gärtner and Beck we must bear in mind that possibly the toxic substances in the intestine, the products of the cholera spirillum, may be more rapidly absorbed at the same time the reabsorption of any water that may be present takes place.

During the recent epidemic in Manila, both hyper- and hypotonic injections of saline solution were employed in a small number of cases, but we were unable to decide definitely in regard to their value. For the routine method of treatment, saline solution of a specific gravity .085 was employed.

We have also used the intraperitoneal injections, but could not convince ourselves that they were as advantageous as the intravenous ones. Such a canula as Major Rogers has suggested would certainly minimize the danger of giving the intraperitoneal injections, and as he has remarked, the intraperitoneal injections may be performed in a shorter time than the intravenous ones. Therefore, the former would be of advantage in a large epidemic where the force of doctors and nurses was inadequate to administer the intravenous injections.

Dr. Paul Clements, medical inspector, Bureau of Health, secretary Philippine Islands Medical Association: I wish to say a word on the mortality of cholera and on the factors which influence that mortality in the provinces, where there are no hospital facilities, where the people are not yet educated to the point of valuing the services of a physician, and where the cholera patient is usually left to the care of his immediate family and the mercies of the *arbolario* (herb doctor).

The mortality during the first two-thirds of an epidemic outbreak frequently approaches 100 per cent. Probably 75 per cent die in from six to ten hours, or a little longer, in the stage of collapse; the remaining 25 per cent die from three to seven days later, of uræmia or from overfeeding. Those who die in collapse are frequently not seen before death, by the health officer. The other cases are usually examined by him. On account of the unwillingness of the family to accept medical advice, even when offered gratis, it is rarely possible to do anything, even for the remaining 25 per cent. Owing to the fact that many provincial towns do not possess a drug store, and that the health officer as a cholera campaigner can not carry very much with him, attempts at medication are seldom practicable even in the few cases which request advice.

The advice which I have usually given in cases where a request has been made is, to administer coffee, strong and hot, in as liberal a quantity as the patient is able to take, to give the juice of native fruits of the citrus family, and to insist upon complete abstinence from food for at least three days. I have seen on many occasions a cholera patient, who had survived the stage of collapse, whose kidneys had begun again to secrete satisfactorily and who was apparently convalescent, die within a few hours after taking nourishment. It may be possible, in a hospital with a well-appointed diet kitchen and a well-trained nurse, to supervise the administration of nourishment for such patients and to begin allowing food twenty-four or thirty-six hours after the subsidence of the severe symptoms. However, in the absence in the barrios of all such luxuries greater precautions are necessary. The clamor of the patient himself for food, when his appetite returns (as it frequently does within forty-eight hours after the subsidence of the severe symptoms) the disposition of the family to humor and encourage the desires of the patient and their belief that if not fed he would soon starve, must all be guarded against, otherwise a quickly fatal result may follow from indulgence in food. In a few cases in which the patient or the members of his family possessed sufficient knowledge to appreciate and follow the advice given, encouraging results have followed. In fact, stating it broadly, I have come to the conclusion that there should be no mortality in cholera except from collapse or from uræmia. In the latter third of an outbreak, a greater proportion of those affected survive the collapse stage, and the disasters of overfeeding become even more apparent. Dr. Andrews mentioned in his paper that abortion of pregnant women attacked by cholera

is almost certain, but I have seen one or two cases in which it did not occur. In the provinces, in the midst of an outbreak any diarrhoea is considered suspicious of cholera, and if that diarrhoea is followed by cramps, we are apt to regard the case as one of cholera.

Dr. V. L. Andrews, assistant, Biological Laboratory, Bureau of Science, Asst. professor of pathology and bacteriology: I am interested in Dr. Roger's remarks with reference to blood pressure. In the work at San Lazaro Hospital I could distinguish, by the reaction of the patients to the intravenous treatment with saline solution, two classes of cases. First, those who would rally and not return to a condition of collapse; second, those who would rally for a short time after each intravenous injection of saline solution, but would in a little while sink into collapse again. In the patients, comprising the second class of cases, there was no abatement of the diarrhoea, and the water seemed to pass out through the intestines as fast as it was injected into the veins; these patients did not always manifest the severest symptoms at the beginning of the disease nor were they always those to whom medical attendance came late in its course.

There seemed to be a point up to which the intravenous solution might be given and the patient rally and remain in this condition, but if one went beyond this point it would not be but a short time before the diarrhoea would apparently be worse and the patient again sink into collapse.

In collapse, the organic constituents of the blood are concentrated, and as the restoration of the normal ratio between the organic and fluid parts of the blood is the thing to be desired, possibly the estimation of the blood pressure by an instrument of precision instead of attempting to estimate it by the sense of touch while feeling the pulse would greatly aid one in determining the stopping point of the injection.

With reference to Dr. Heiser's remarks that the virulence of an epidemic always decreases toward its close I will state that the figures of the present epidemic show a decrease of only 5 per cent between the mortality of the first half and that of the last half of the epidemic. I think that this difference can be attributed to improved facilities in the discovery of the cases in the early stages of the malady, and their prompt removal to the hospital rather than to a decrease in virulence of the disease.

Dr. Strong: In Dr. Andrews's paper I believe that all of the more important points in reference to the treatment of the disease were referred to. I might add a word in regard to the treatment of severe dyspnoea. Dyspnoea occurs commonly in cholera as a symptom of collapse, and is an evidence of failing circulation and disturbed cardiac action. Sudden and severe dyspnoea may also occur apparently either from the development of coagula in the right heart or to a spasm of the smaller pulmonary arteries, in which case the vessels of the lungs are unable to transmit the

thickened blood. If the dyspnoea is due to the latter cause, life may sometimes be saved, provided immediate measures are instituted. Nitrate of amyl should be administered at once with the object of overcoming the spasm of the arteries and intravenous injection of saline solution rapidly given at the same time, with a view of increasing the pressure and of diluting the thickened blood. During the recent epidemic, two cases of sudden dyspnoea and marked cyanosis were treated in this way, in both of which the symptoms quickly disappeared and the cases eventually recovered.

Dr. Paul C. Freer, Director of the Bureau of Science; professor of chemistry and dean of the Philippine Medical School: The statements of Dr. Rogers which are so well in conformity with those of many others, that the severe symptoms of cholera are caused by losses of fluid from the blood, brings us to the question as to how the action of the soluble toxin is produced. We have discussed that question considerably in the laboratory and I would like to hear from some of the biologists of what they think about the subject.

Dr. Oscar Teague, assistant, Biological Laboratory, Bureau of Science: What I might say with regard to the cause of the diarrhoea in cholera has only a theoretical interest and the experiments of Dr. Strong and myself have developed as yet no new facts in this direction.

It might be thought that since the cholera vibrio is one of the most motile organisms with which we are acquainted and since it penetrates the superficial layers of the inner lining of the intestine, the mechanical stimulation of the nerve endings thus produced might set up an increased peristalsis and resultant diarrhoea. But the consensus of opinion is that the diarrhoea in cholera is due to a toxin, and in certain animals a diarrhoea is produced when killed cultures of the cholera vibrios are injected intravenously. Whether the toxic substance concerned is a true soluble toxin or an endotoxin, which is set free only after the death and disintegration of the vibrios, is still undecided. It seems to me that probably both the mechanical irritation of the motile vibrios and the cholera toxin are factors in the causation of the diarrhoea.